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LECTURE.

Friday, May 10th, 1867.

W. STIRLING LACON, Esq., in the Chair.

SUSTAINING AND LOWERING SHIPS' QUARTER-BOATS.

By Captain C. B. Simpson, R.N.

My position this afternoon—that of advocate in my own cause—is one so well understood by Members of this Institution, that I feel an apology to be superfluous. I will, therefore, at once proceed with the object I have in view, viz., that of introducing to your notice a plan for hoisting, sustaining, and lowering quarter-boats at sea; and by comparing it shortly with the modes at present in use on board Her Majesty's ships, endeavour to bring out the relative merits and defects of the different plans.

The plans at present in use are, Captain Kynaston's and Mr. Clifford's.

Captain Kynaston's plan will be best understood by reference to the drawing (Plate xli); and, as will be seen, it retains all the old arrangement of falls, grips, &c., simply substituting his disengaging hooks for the common hooks. The operation of lowering, in his case, is this:—On the boat being required, after the crew are in the boat, the grips have to be cast off, and the boat lowered by the falls in the ordinary way; a third man in the boat being required to attend the disengaging-line, which, when let go, disengages the boat. There are, therefore, after the grips are cast off, two, if not three men, necessarily employed in the operation of lowering. The principal objection, however, to the plan is, I think, its complication, and the number of moving parts dependent upon each other for safe and accurate working. For instance, there are no less than five different ropes, two falls, and three different parts of the disengaging lines, with four ends belayed to different cleats, any accident to any one

of which, by slipping, by carrying away, or by unequal lowering of the falls, or easing of the disengaging lines (which depend for their equality of working upon the freedom from rust and perfect order of no less than two sheaves and two bearings in each hook), would be the cause of serious accident.

In addition to which, notwithstanding the claim made to the contrary, I consider these hooks to be most clumsy and difficult to handle for hooking on in a sea-way; it is true that when once hooked, and the lines hauled taut, and the relieving-bolt in, that the boat will not again become unhooked; but two men are required to each hook to perform this operation, one to attend the hook, and the other the disengaging line, and I think the following paragraph, from Captain Kynaston's paper of explanations, will convey some idea of the difficulty likely to follow from the necessity of requiring two men to take the boat at the right bob simultaneously.

The hooks for hoisting boats should be always attached to the boat's slings—never to the tackles. Any one who has been bobbing about in a boat, under a ship's davits, vainly endeavouring to hook her on in a sea-way, can speak feelingly of the risk a boat and her crew have to encounter at every surge, from the playful sallies and tenacious grip of the hooks, when fitted in the usual manner to the boat's tackles. To disengage suddenly, under such circumstances, from a ship moving through the water, or indeed when stationary would be fraught with the greatest danger, whatever kind of hook be made use of.

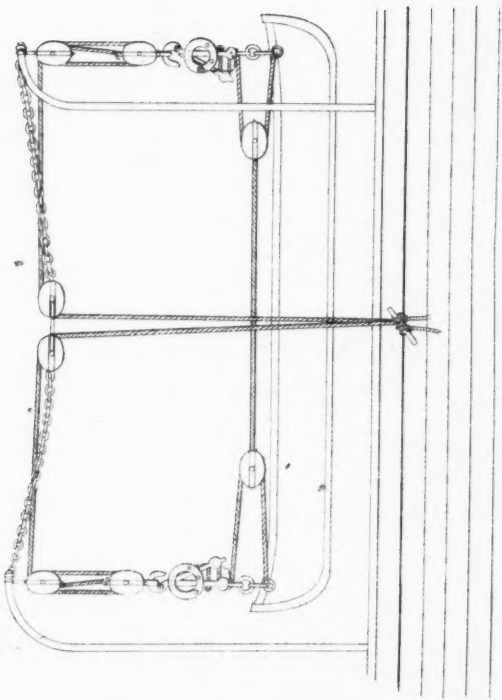
Mr. Clifford's plan, as shown in Plate xlii, is as follows:—A roller is fitted in the centre of the boat, which works freely in bearings at each side of the boat under one of the thwarts; to this roller a rope is made fast, and wound on it to a length equal to the distance the boat will have to descend from the davits to the water. Two single ropes or pendants are made fast to the davit-ends, and rove through the three-sheaved blocks attached to the boat-slings, then through the leading blocks at the bottom of the boat, and the ends of each are entered through the same hole in the roller, but in opposite directions. By hauling on the lowering-line, before mentioned, which is wound on the roller, the pendants will be wound on the roller to the same extent that the lowering-line is unwound. The three-sheaved blocks act so as to nip the pendants, breaking the strain to the man lowering, and giving him control over the descent of the boat, whatever its weight may be. The nip of the three-sheaved blocks only exists so long as there is any strain on the pendants passing through it, and ceases on the lowering-line being let go on the boat reaching the water.

The grip is made in two parts, with thimbles at each end, and held together by a lanyard.

When the boat is hanging on the pendants, the grips are passed round the boat, and the thimbles are passed up the prongs attached to the davits for that purpose, the lanyard is then hauled taut, and thus the boat is secured to the ship's side.

When the boat is lowered, the thimbles slip down the prongs, and the boat is free.

Here, I think, we have a great advantage, at any rate as far as the lowering is concerned; for though there are still three different ropes



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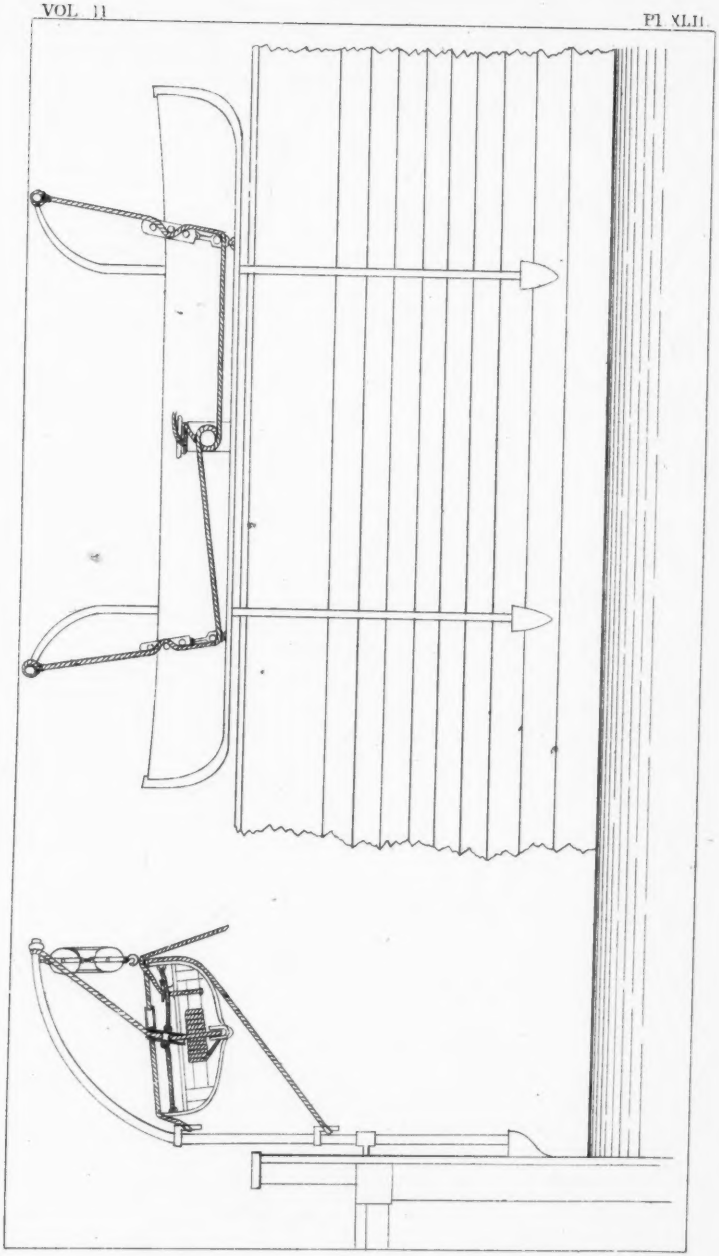

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employed in the operation of lowering, an accident to any one of which would be fatal, yet they are all under the control of one man, and he has only to perform one operation in lowering the boat, viz., to ease away the lowering-line, and if the tapered pendants will always unreeve clear from the roller, the plan, as I said before, as far as the simple lowering is concerned, is excellent. But I still venture to think that there are serious objections to the plan as a whole.

Firstly, the space occupied in the boat by the roller, interferes materially with the boat's stowage, and there is the chance of fouling the pendants when lowering, if the bottom of the boat is not kept clear.

Secondly, I believe the plan of the grips to be most injurious to the boat, and dangerous to the crew when lowering.

A few words will explain what I mean.

It is evidently not only advantageous, but absolutely necessary, that the davits should be made to carry the boat as far out from the ship's side as possible, to prevent, as far as may be, her being stove when being lowered or hoisted in a sea-way. It will also be seen, that if the least play is allowed to the boat by the grips, the latter, if the ship rolls at all heavily, will become unhooked, consequently it is necessary for the boat's safety, that she should be bound by the grips taut up against the davits, so as to preclude all play; but the result of doing this is, that in a short time the gunwale of the boat becomes completely crushed in by the grips, and the boat is rendered useless. This statement may appear an exaggeration, but I can answer for its having been the case in the last vessel I commanded, and also am informed that it was the case with several others on the same station.

These grips are also dangerous; for if, when the boat is bound up against the davits, as before stated, the lowering-line is eased away, the boat, when the grips slip off the spurs, will swing violently outward, especially if the ship is rolling heavily at the time, and the send of the ship happens to coincide with the swing of the boat; and if the boat is not rapidly lowered, so as to reach the water before she returns towards the ship, she is in great danger of being stove against the side.

Thirdly, there is not only no advance on the old plan of hoisting up, but there is a serious additional drawback in the length of time that the boat must necessarily hang unsecured after hoisting, whilst the pendants are being rove, and the tedious operation of a second hoisting is going on, this being rendered necessary in order to get the pendants sufficiently taut to hang the boat the required height.

It was my practical experience of the defects in the plans I have shortly put before you, that induced me to try and devise some plan that should obviate them. The result of my endeavours I will now bring before you. I must ask you, however, gentlemen, not to expect perfection; no doubt if I have succeeded in obviating some of their defects, I shall have introduced others; but I shall be satisfied if the relative advantages of my plan outweigh, in however small a degree, its disadvantages.

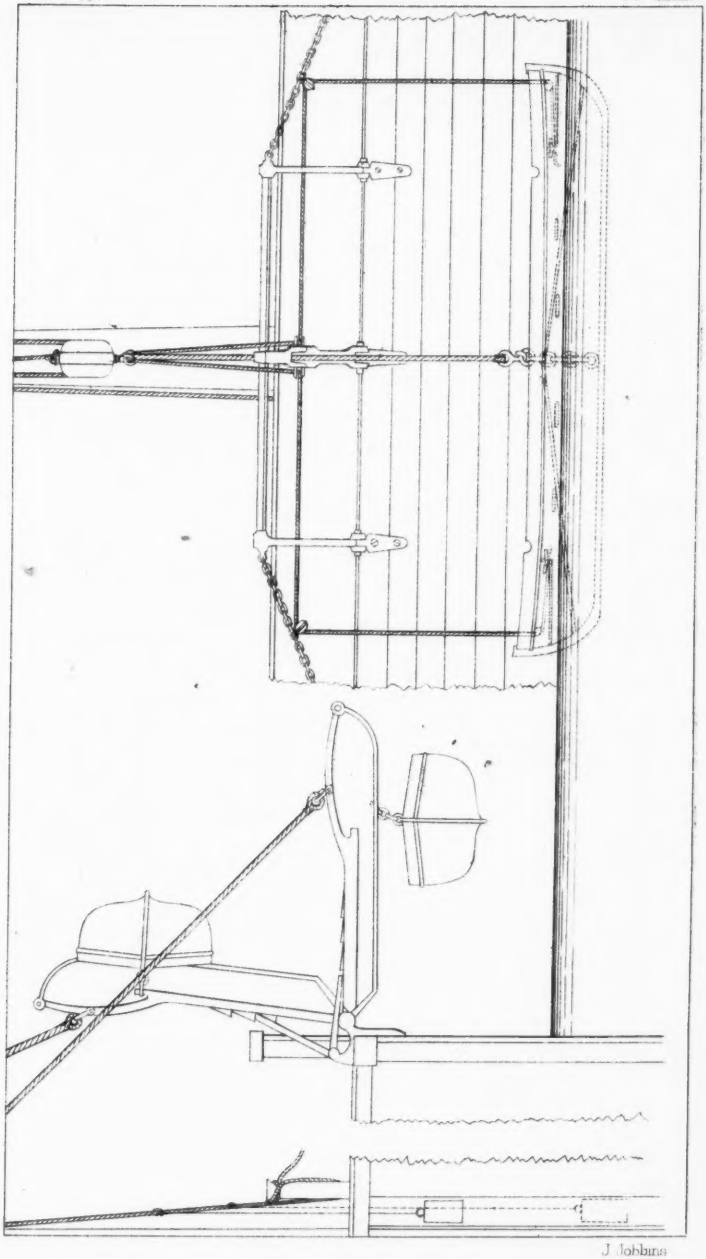
My plan (see Plates xliii, xliv) consists of three arms or davits combined, and acting in one frame, these arms are each jointed to brackets

or knees fixed to the side of the ship, and are placed at equal distances apart. The joints of all three being in the same horizontal line, the davits are free to describe a semicircular arc; that is to say, they may fall down against the outside of the ship, and be raised upwards and inclined inboard over the bulwark. The middle arm is the strongest of the three, having to support the principal weight of the boat, which is supported therefrom by a straight hook, or spur-like projection, or tongue, formed on the under side of it, about two-thirds out. The other, and extreme arms, are each in one of the forms shown in the drawing; the plain straight one being intended for small vessels, where the davits will not be required to be lowered below the horizontal. The other, applicable to large vessels, having their outer ends formed as portions or segments of a circle, round which the gunwale of the boat glides when the davits are lowered beyond the horizontal; the boat is thus in both cases kept firmly in the horizontal position until the ring attached to the boat's slings, by which she is suspended, slips off the spur by reason of its incline, when the boat is free. The extreme ends of the arms are connected by a suitable tie-rod, so that all three arms move together on their hinges as one frame, and the whole is raised or lowered by a single rope or chain attached to the centre arm, led up to the mast or other standard over a pully, and down to the deck to a point where it can be eased away with certainty and facility. A counterweight, sliding freely in a tube placed up and down the mizen-mast below the deck, as shown in the drawing (Plate xliii), is attached to this chain or pendant, acting upon it within certain limits, so as to ease the descent of the boat, and to raise the davits, immediately they are relieved from the weight of the boat, to the hoisting position.

A sheave is fitted in the centre arm, near the position of the supporting hook, or spur, over which sheave a rope or pendant is rove, for the purpose of hoisting the boat into position, to be supported by the davits. Thus both, when hoisting, and when the boat is in position, the davits act as a derrick to keep the boat out from the ship's side, the weight of the boat being almost entirely thrown upon the mast or standard.

The boat is suspended by longitudinal and cross slings from either end and side of the boat, which are secured to a ring, and slung amidships, the whole terminating in a single ring, or hook, by which the boat is hooked on to the lifting pendant. A second ring is connected with the slings, which is to be placed on the hook, or spur, before mentioned, and by which the boat is wholly supported when fixed in position. The slings supporting the boat have a part carried down to the keel of the boat, by which the more direct weight is supported.

The hook or spur which supports the boat is made either to project in a line with the mid-arm, or is inclined a little to its plane, according as it is determined to detach the boat before the davits arrive at, or after they have passed beyond, the horizontal position. On each side of the central arm also, abreast the sheave before mentioned, are two small rollers, underneath which two steadying lines, which are spliced into the upper eye of the hoisting pendant, are rove, and led through



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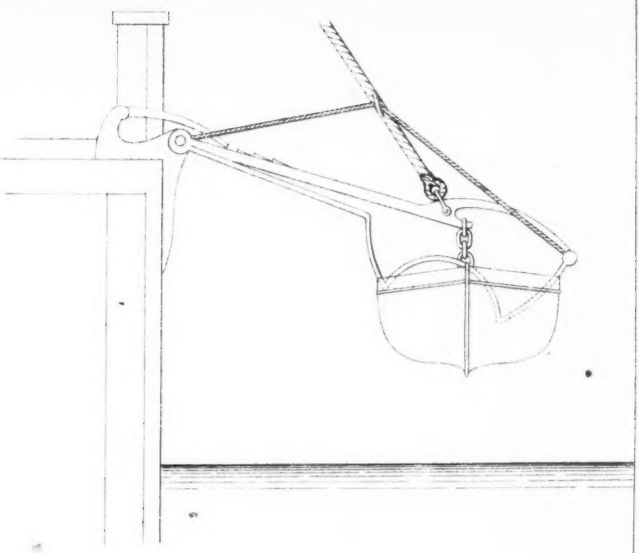
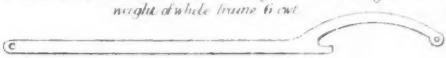


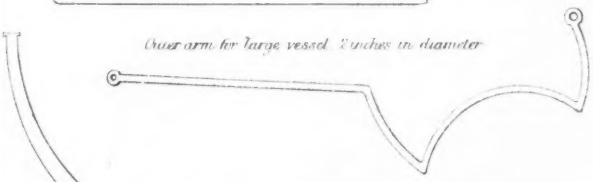
Centre Davit for small vessel 4 inches by 3 whole length 10 feet
weight of whole frame 6 cwt



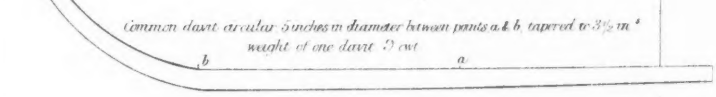
Outer arm for small vessel 1½ inch in diameter

Centre davit for large vessel 5 inches by 4 whole length 12 feet
weight of whole frame 10 cwt

Outer arm for large vessel 2 inches in diameter



Common davit circular 5 inches in diameter between points a & b, tapered to 3½ in.
weight of one davit 2 cwt



J. Jobbins

blocks on the fore and aft guys, so as to plumb the bow and stern of the boat, so that when hoisting, as soon as the hoisting pendant is hooked and hauled taut, the steadying lines, which have been previously rove through small eyes or blocks at the bow and stern of the boat, are hauled taut, and a turn taken with them. The boat will then be hoisted steadily out of the water, all three ropes rising exactly at the same speed, until the gunwale comes in contact with the extreme davit arms, when the ring before mentioned is placed over the spur on the central davit. The hoisting pendant is then slacked up and unhooked, and the steadying lines unrove from the boat, when she will be firmly secured to the davits by her own weight, without the aid of grips, and be ready for lowering.

Grooved chocks are fitted on the inside of the gunwales of the boat to receive the extreme davit arms, and prevent any motion being given to the boat by the pitching of the ship.

Teeth are provided on the mid-arm, and a paul, by which the position of the davit frame is regulated.

When it is desired to lower the boat, it is simply necessary to ease away the single supporting rope or chain, so as to lower the davit frame outwards, until it reaches a certain predetermined position, when the ring supporting the boat from the hook or spur will slip therefrom by reason of its inclination, while the boat will be free to fall into the water, and this without the possibility of mischance.

I think it will now be sufficient for me to point out shortly some of the advantages I believe my plan to embrace, and hold myself in readiness to answer, as best I may, the objections to it that may occur to my hearers.

1stly. There are no extra fittings or gear in the boat to interfere with the stowage.

2ndly. That there are no grips to cast off.

3rdly. That in lowering there is only one operation to be performed, by one man, viz., easing away the topping lift, and this not amongst a confused heap of men just bundled in the boat, as in Clifford's case, but on the deck of the ship, apart from all confusion.

4thly. That the boat is kept rigidly in position on the davits up to the moment of her release.

5thly. That from the fact of her being attached from one central point only, there cannot possibly be any irregularity in the operation of lowering, but that the boat must fall into the water on an even keel, neither will the motion of the ship (except to a small extent, to be hereafter explained) alter the predetermined height from the water at which the boat is to be freed.

6thly. That no plug is required; the boat is cleared of water by simply topping the davits.

7thly. That the boat is carried by the action of the davits when lowering completely clear of the ship's side.

8thly. That the davits will, in hoisting, keep the boat so far from the ship's side, and, from being nearer to the water when in position for hoisting than the old davits, give the boat so much less play as to preclude the possibility of her being stove.

And, lastly, from there being only one single hook to hook on for hoisting, the danger and delay from first one fall and then the other becoming unhooked, and the necessity of keeping the falls clear of turns is avoided.

I wish to call special attention to the hoisting, as I believe that by the adoption of my plan, hundreds, if not thousands a-year, would be saved to the country which are now spent in the repair of boats, stove in hoisting; besides the inconvenience and delay to the service thereby entailed.

Before concluding I must refer to one important point. I have said "neither will the motion of the ship, except to a small extent, alter "the predetermined height from the water at which the boat is to be "freed."

Now, it is evident that if the davits could be hinged to the centre of motion of the ship that no variation could take place in the predetermined height from the water at which the boat is to be freed; whatever the list or rolling motion of the ship might be, that height would remain the same, whether the boat were brought to it by lowering the davits, by the inclination or roll of the ship, or by both combined.

But unfortunately the davits cannot be hinged to that point, but must be hinged to the side of the ship. What then will be the effect of this?

I will take an example to illustrate it. Supposing a ship of 36 feet beam abreast the mizenmast to have her davits hinged to the side 10 feet above the water line, a list of 15 degrees will elevate the davits on one side about 5 feet higher above the water than when she is upright, and bring the other, or opposite, davits the same distance nearer to the water level. Now, suppose the tongue or spur on the davit from which the boat is suspended to be placed at such an angle as to free the boat when the ship is on an even keel, 5 feet above the level of the water, we should have, when the ship is heeling 15 degrees, to drop the weather boat 10 feet, and the lee boat would be freed just as her keel touched the water.

If the ship was rolling 15 degrees each way, either boat would be freed at some intermediate point between these extremes.

Now, taking for granted, as I do, that a maximum drop of five feet for a boat, could never cause her the slightest injury, all that we have to do, is to place some permanent stop on the topping lift, by means of a toggle, or any simple plan, so as to preclude the possibility of the davits being lowered beyond the position they would have to attain, in order to free the boat when the ship is upright; and to make the rule, that when under sail with a steady list, the lee boat is to be used. The boat will then be invariably freed at some intermediate point between the water line and five feet above it; and be it remembered, that no error in judgment in the man lowering can alter this—his judgment has nothing to do with it, and the boat will be lowered with the same ease and safety on the darkest night as in broad day.

It may, however, be asked, suppose the ship to have a steady list of more than 15 degrees, what would be the result?

I would answer, that in our example we have the keel of the boat

only brought on a level with the water with a heel of 15 degrees, and that the ship will be required to heel some 20 degrees before the boat will be sufficiently buoyant, by reason of her immersion, to prevent the davits descending to the required angle to free her. Also, that unless the water is as smooth as this table, a minimum heel of 20 degrees can hardly be conceived, especially in the present days of undermasting; but even if such a case could occur, the boat would almost invariably be released on striking the water, even if the davits had not reached the required angle, and in any case, no harm could happen to the boat or crew, for as long as the boat is attached by the ring to the davits she is kept firmly in position by them, and by reason of the counter-weight will float far more lightly and buoyantly on the water than if free, and consequently will tow in that position with perfect safety; and if (as, however, is impossible) the ship should not right sufficiently to free the boat, by simply pulling up the topping-lift the boat will be hoisted into position again, and secured. The boat will in such a case have failed in her object certainly, but she will have sustained no injury, and the crew will be safe.

I think I have now touched upon all important points, except perhaps those of weight and expense.

The weight of the davits in my plan will, I think, certainly be less than that of the present ones. Firstly. For the reason before stated, that the centre arm, the only part of the davit which bears any of the weight of the boat, acts simply as a derrick, and is in no case subject to any cross strain, the outer arms acting simply as guides and steadying bars to keep the boat in position. Secondly, that the length of the davit arms need only be about half the length of those at present in use in small vessels. For instance, in the example before us, I would propose that the extreme length of the davits should be ten feet. This would drop and hoist the boat 7 feet clear of the ship's side, and carry her, when topped up, a clear 15 feet above the water.

In point of expense, I do not anticipate any material difference from the present methods.

The CHAIRMAN: I should like to ask Captain Simpson whether he has tried this plan practically; whether he has fitted it to any ship.

Captain SIMPSON: No, I have not; I have only tried it on a small scale.

The CHAIRMAN: You spoke of the ship's davits being only ten feet in height above the water; are not line-of-battle ships' davits very much higher out than that?

Captain SIMPSON: I think the days of line-of-battle ships are rather gone by; but, of course, the higher the vessel, the longer she would require the davit to be. The length of the davit would have to be proportioned to the height of the ship out of water. If the davit were fixed only about 10 feet in height above the water, the length of the davit would be 10 feet; if it was needed 14 feet in height, its length would have to be 14 feet. A davit only 10 feet in length will carry its boat 15 feet above water.

The CHAIRMAN: Supposing you had an order from the Admiralty to

fit your plan to one of their largest ships, where would you fit your davits?

Captain SIMPSON: So as to drop the boat about six feet from the water.

The CHAIRMAN: Would not your davits come very low down?

Captain SIMPSON: Not necessarily. It depends upon the length of the davit. You can bring your davits close to the water if you like. I consider it perfectly safe to drop a boat 5 or 6 feet.

The CHAIRMAN: Would it not hurt a heavy boat full of men to drop that distance?

Captain SIMPSON: I think not. Five or six feet, I think, is perfectly safe.

Evening Meeting.

Monday, May 20th, 1867.

CAPTAIN FREDERICK A. B. CRAWFURD, R.N., in the Chair.

FLEET MANŒUVRING.*

By Commander POWNOLL W. PELLEW, R.N.

AT the commencement of a paper on so important a subject as the evolutionary system proposed for the future manœuvring of our magnificent steam fleets, it will be right, I think, to enter a disclaimer against being thought to assume any more special knowledge of the subject than can easily be acquired by any one interested in so doing. There are, however, a great many of my brother Officers who doubtless have not had the same opportunities of gaining experience on the subject that I have had; and to them and any others who may think the matter of any importance, I will address myself.

On joining Sir William Martin, in 1861, as his flag lieutenant, I found him employed on the revision of the present system of evolutions, and consequently for the next two years I was also employed on that subject, during which time, one written and three printed editions of a revised system, intended to suit the requirements of the present day, were brought out.

During those two years, we had not only had the advantage of a considerable amount of steady practice with the squadron itself, in the Bay of Naples, but also of a constant series of exercises with the boats of any of the ships chancing to be in company with the flag-ship. Officers employed about it will not easily forget the continual cruizing up and down Malta harbour, or about the anchorage at Corfu; while, as a further means of ventilating the subject, before and after nearly every practice, the Officers detailed for that duty used to assemble on board the flag-ship, where proposed evolutions would be discussed, and opinions be freely asked and given.

* The sketch here given, is immediately to be followed by a publication on the same subject, going into the whole of the propositions in detail. 8th Nov., 1867.—P.W.P.

The Admiral had also the satisfaction of receiving opinions highly favourable to his views, from the Captains of the ships composing that squadron of evolutions. The book, however, was not approved at home, and I dropped the subject until April, 1865, when I was appointed, together with Commander Colomb, to assist Sir Sydney Dacres in a contemplated total revision of the Naval Signal Books. Unfortunately for me, however, after about six weeks work, my health broke down, and I was forced to give up my appointment, not, however, before having had the opportunity of seeing and taking notes of all the propositions on the subject that have from time to time been presented to the Admiralty by many distinguished officers.

With this short preface, I now propose to bring to your notice, and explain in as brief a manner as possible, the formations and evolutions, that seem to me to be absolutely necessary for the proper manœuvring of steam fleets. It is not, I fear, a subject that can be made particularly interesting. I am not going to slip into it any reviews of old naval battles, nor, even if I had any, am I going to launch my ideas as to the manner in which new ones are to be fought; I propose simply to sketch out a plan, by means of which I consider a fleet may be kept perfectly in hand, while being manœuvred with the utmost possible rapidity and freedom.

The first point in order, will naturally be the proposed sub-division of the fleet, and in immediate connection with it, the various formations that it would be advisable to provide for.

The present organization divides the fleet into two divisions, and each division into two sub-divisions; or into three squadrons, and each squadron into three sub-squadrons. A sub-division and a sub-squadron are therefore two different things, and it is a very difficult matter, as has often been proved, to work the two arrangements together. It is also inconvenient, and seems like a mistake to have arranged, that the half of the fleet should only be sub-divided into two parts, while the third of it, is sub-divided into three. Thirdly, it is impossible with such a sub-division to arrange any convenient plan, by which the fleet can be passed from two to three, or from three to two columns.

As a complete remedy for all this, I should propose that the fleet should be primarily divided into six sub-divisions, three forming a division, and two a squadron, the unit or sub-division of each of which being the same, does away with the old jumble of four sub-divisions, and six or nine sub-squadrons, and enables an additional order of steaming, "that in sub-divisions" to be provided for use, if required.

This sub-division of the fleet almost settles for us the character of the formations we have now to arrange. For as it is difficult to think of anything more manageable in the way of a formation, than one or more columns, and as a small fleet would naturally be in one, a little larger in two, and larger again in three, it is evident that such a sub-division as I have described, will exactly suit this arrangement. I say a fleet is formed naturally into columns, by which I mean ships at equal distances apart, ranged on one line; for though we hear of double lines of bearing and indented lines, yet these are looked on merely as exceptional formations, and in the case of the latter at all events will, I

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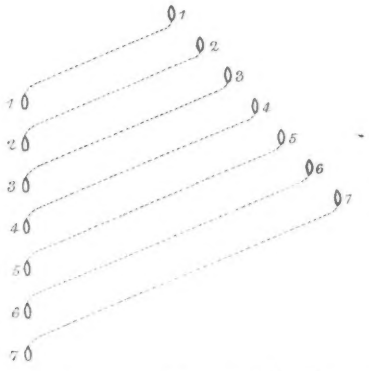

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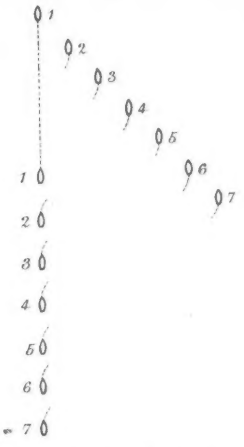

Comparison of the methods for forming a line ahead on a four point bearing.
Proposed. New System. *Old System*

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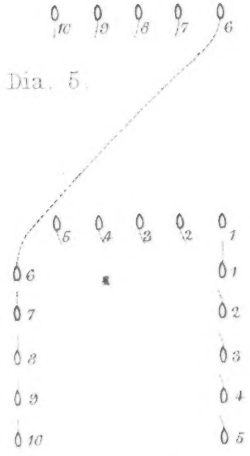
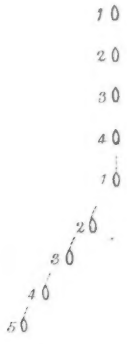
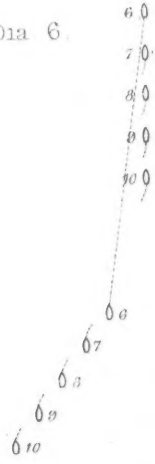




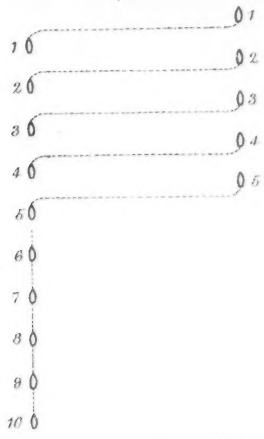
Dia. 6.



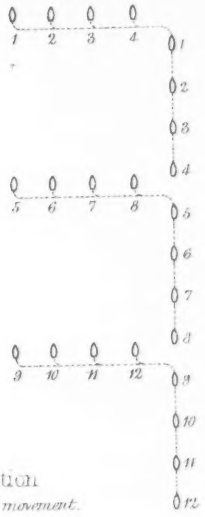
Second Class of Evolution.

Changing the class of a formation by turning it on a pivot.

Dia 3



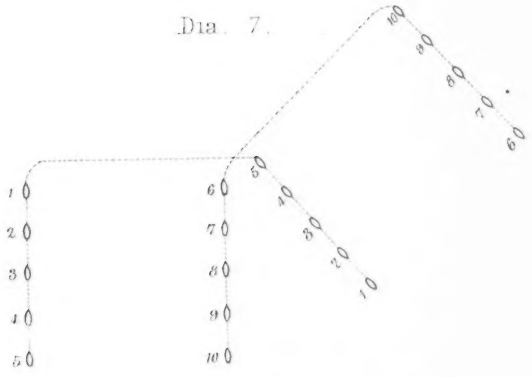
Dia 4



First Class of Evolution

Changing the formation by a Flank movement.

Dia 7.



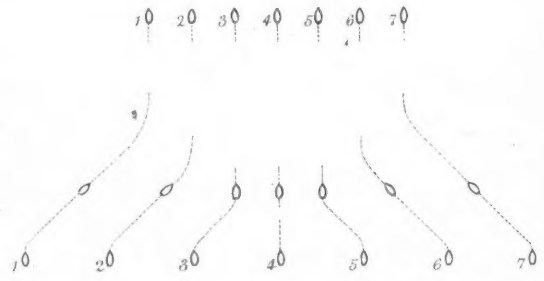
Third Class of Evolution

Changing course by a Flank movement.

Dia. 8.

Fourth Class of Evolution.
Changing course by wheeling.

Dia. 9.



Seventh Class of Evolution
Decreasing distances between adjacent Ships

J. Jobbins

am sure, be found totally unsuitable to the requirements of the present day.

It will further be found on examination, that, to enable a fleet divided into more than one column, to be manœuvred with the greatest facility, the columns should be opposite each other, and at a distance apart about equal to their length.

For general purposes, I should consider the three formations described above, as a sufficient number of what may be called "general formations;" but as we have a further division into sub-divisions ready provided, and as such a formation might in exceptional cases be useful, I should include an order in sub-divisions, on the same footing as the others.

I have especially restricted to three the number of columns in which a fleet should be usually manœuvred, because everything seems tending to the belief, that fleets in future are not by any means likely to consist of so large a number of ships as formerly; more particularly as I should propose that fleets of any size should invariably be divided into two or three small fleets, capable of being manœuvred separately, and thus so reducing them in size, that the one, two, and three columns, formerly found sufficient for sailing fleets of enormous magnitude, would be surely sufficient for the free manœuvring of the more moderately sized fleets propelled by steam, that I am trying to provide for.

This system of cutting up large fleets into smaller bodies so much more easily manœuvred, I consider to be of essential importance, especially with respect to the facilities it affords for rallying or detaching, and for keeping the ships together at night. To understand the arrangement, the division into smaller fleets must be considered quite independently of the regular fleet organization, which is applied in its full extent to each; they would be called the van, centre, and rear, or the van and rear fleets, and under their own commanding officers could each of course be worked independently. When, however, it was desired to manœuvre as one fleet, the small sub-divisions, into which, according to the fleet organization, each fleet is divided, must be clubbed together by twos or threes, according to the number of fleets, so as to form six large ones in all, and the whole can then be manœuvred as one, until again required to work independently.

At present one column, two and three columns, with no means of passing from one to the other, a couple of signals proposing to form four and nine columns never used, because the necessary directions are not given, are all the formations in line ahead. Then we have a single line abreast, a single line of bearing, and the double lines of bearing, and, as far as my memory goes, that is all. Many people, eager for simplicity, and thinking only of convenient formations for cruizing in, will say that that is quite enough, but I will endeavour to show, that if only to avoid great unnecessary loss of time in manœuvring, there must be a great many more: there was a great want of freedom, also, in the manner of getting into or out of these formations, few as they were.

Suppose now a fleet in two lines ahead, which for some sudden reason, perhaps no room to wheel, or change the course on a pivot,

alters course together eight points to one side or the other, they are now in two lines abreast, and how are they, keeping their present course, to get back into their two lines ahead? At present there is no recognized way, and the Admiral would have to invent some special contrivance suitable to the occasion; and this shows that two lines abreast should be one of the regular formations, as well as two lines ahead; and changes of formation should be capable of being made to and from it, although it might not be considered a desirable formation for cruizing in. There are numerous other occasions on which it would be equally convenient, and whatever may be said for two lines, may also be said for the three and six lines, into which the fleet can be sub-divided.

But it may not be necessary, or desirable, to change the course either precisely eight, or sixteen points, and any other course adopted simultaneously, will throw the fleet on oblique lines; now for some reason it is wished immediately to change the formation, but nothing can be done, because of this kind of formation, the single column only is recognized. It is therefore desirable for this among other reasons, that there should be certain means of manœuvring when the two, three, or six columns, chanced to be thrown on oblique lines, or that they also should be "recognized formations."

We have thus arrived already at twelve formations, but there is no occasion for counting up to so high a number; by calling the single column the first formation, the two divisions the second formation, the three squadrons the third formation, and the six sub-divisions the fourth formation, and according to the coincidence or otherwise between the course steered and the line of the columns, classing them as in "line ahead," in "line abreast," or on an "oblique line of bearing," we can stop at four formations.

There is yet one other essential to be provided for, a point of which very little notice is taken in the present arrangement; it is to provide for the principle, that it is as likely to desire to form the lines abreast with the numerical succession counting from one side as the other, and the formations in line ahead, or on oblique lines, with the columns ranged in order from the "left front," as from the "right front:" to provide for this, we must have two orders of each formation; with the sub-divisions placed in succession from the "right front," the formation is in "direct order," and if from the "left front" it is in "reverse order."

The only other formation that I think needs to be provided for, is that at present called "on double lines of bearing," but which I should call after Sir W. Martin, the "angular formation;" it consists of the whole or any indicated portion of the fleet, divided at or near its centre ship, from which the divided parts called the Van and Rear wings, can be placed on any desired bearings forming an angle with each other; it may be formed in "direct, or reverse order."

These are all the formations that it seems to me to be necessary to provide for. Such a number as six columns are quite as many as it would be desirable to manœuvre together, but if more are required, I would provide for it as I have already explained, by dividing the fleet into two or three smaller fleets, which by being worked separately will

allow for an almost unlimited number of columns, and will be altogether in my opinion, a more desirable manner of manœuvring large fleets.

I wish here again to disclaim altogether any intention of suggesting formations for taking a fleet into action; so many people confound the mere manœuvring of a fleet, intended to be provided for in a system of evolutions, with the special arrangements that would be required for action, that such a disclaimer is necessary. One of the most common objections one hears, is, that in the smoke and excitement of action, every Captain would have to act as his judgment directed, and all these signals would be of no use; forgetting that the manœuvres before a battle are often more influential as to its result than the actual chances of the fight. With a large number of ships at the distance, that from their size, they will require to be kept apart, there will still be constant opportunities for making a concentrated attack on some one portion of an enemy's fleet before the other can come up, short it may be, but with the modern improvements at which we are arriving, not perhaps proportionably sweet. It may be an object to place your fleet before the attack, between the enemy and his port, or to get at a convoy he is protecting; to do these things, and at the same time to be prepared for any counter-strokes, there must not only be almost unlimited powers of manœuvring, but any means that may have been provided, will require to have been previously well studied and practised; while, independently of all this, an Admiral will still have as heretofore, to make his own plans for the actual conflict.

It will be natural to suppose, considering their variety, that any such selected plan of attack might be based on one of the formations provided, at any rate that it could be more easily delivered from some particular one, than from the others, and therefore a thoroughly free system of manœuvring such as I here recommend, will be useful up to the latest moment. With this end in view, while preparing the system of changes of formation, I am about to describe, it has been my endeavour, while making the evolutions take up the shortest possible space of time, to give as much variety as possible, and it may be that in doing so, particularly in such cases as changing the direction of the line of bearing and others analogous to it, a certain amount of precision and regularity has been sacrificed, at all events to the appearance of the evolution. I will, however, at once confess that I do not attach such very great importance to mere regularity; a line of bearing, or a line abreast, is equally efficient as far as the bow fire is concerned, although the ships may not be by any means in an exact line, and as that is in all probability what is required, I would not delay getting it for a single second more than is absolutely necessary. In contrasting for instance the plan I should adopt, which in substance is that which already exists in our Navy, for changing from a line ahead to a four-point bearing, with that proposed in the French book and in other quarters, I should say, that while they sacrifice time to regularity, we, though not on account of any departure from these suggestions, sacrifice regularity to time. At the same time I do not admit that we sacrifice any essential regularity, any more than that they, by a plain sacrifice of time, have really gained it.

Again, by insisting that each ship should always turn on a certain sized circle, you evidently suppose that every ship is in her exact position. But from what I have seen of manœuvring ships, whose officers were doing their utmost to keep them in their station, and where, the evolutions being only performed for exercise, plenty of time was allowed, I am led to have great doubts as to any great precision being arrived at when a fleet is being hurriedly manœuvred, and with lines irregularly formed; every advantage should be taken of any turns, simultaneous or otherwise, that may be demanded, in order to rectify their positions.

To return now to the means provided for making a change from one formation to another. The four general formations in the two classes of line ahead and line abreast, are made capable of being changed from any one to any other, involving in all, one hundred and twelve changes, and these are all provided for in eight signals. With regard to the third class, or the formations on an oblique line of bearing, I have found it impracticable to do more than make them interchangeable on similar bearings, but by wheeling them on a pivot, they can be changed into the other classes of the same formation.

As to the angular formations, they can be formed in either order, from single columns, and changed back into single columns of any class of formation.

It being so absolutely essential to provide that each change of formation may be made with reference to the new formation being desired in "direct or reverse order," and also so desirable to provide for manœuvring without reference to the relative positions of particular ships, it is arranged, that when once formed in a formation, the evolutionary names or numbers of its various component parts shall be wholly positional, original names or numbers when alluded to, having the word "prescribed" affixed to them. Any ship chancing to be leading is therefore called the "leader," the sub-division that comes first, the "first sub-division," while the divisions and squadrons will take their names in accordance with the numbers of the sub-divisions. Although the sub-divisions are thus made entirely interchangeable, it will be seen that as to the individual ships of which they are composed, their order is not disturbed, and that they will always be found placed with their "prescribed leaders" towards the same extremity of the column or formation, and this therefore fixes for us an extremity of each column, which I call the "leader's end," from which extremity, the compass bearing of the line of bearing called the "column bearing," is always taken.

I will now proceed to describe the evolutions by which it is proposed to effect these changes of formation, and otherwise manœuvre the fleet: they may be classed as follows:—

1st. To change the formation, by a flank movement.

2nd. To change the class of a formation, by turning it on a pivot.

3rd. To change the course of any formation, by a flank movement.

4th. To change the course of any formation, by wheeling it on a pivot.

5th. To exchange the positions of any two columns.

6th. To invert the order of the ships of any column, and

7th. To increase or decrease the distances between adjacent columns or ships.

To begin with the first in order, or "changing the formation by a flank movement." What is here called "a flank movement," is a class of evolution first brought prominently forward in connection with Naval Manœuvring, in the French book of Naval Tactics translated by Captain Phillimore; being mathematically the quickest, it will also be found practically the most advantageous method of making the changes of formation in which it is employed, having this additional great inducement to its use, viz., that of not requiring the speeds of the ships to be interfered with. Its principle is, that the rear ships, or columns, shall be the standard by which the formation is to be completed, instead of the leading ones, as formerly; and on account of its obvious advantages, I have employed it in all the one hundred and twelve interchanges between the formations in line ahead and line abreast. Diagrams 3 and 4 (Plate xlv) will show the style of movement, and on comparing it with the same evolution, as performed by the old method, the gain is at once apparent. In the given example, where the one column in line ahead is being changed into two, it will be seen that without any change in the speed, or any difficulty in deciding on the change of course, the new formation is completed, as soon as the rear division can fetch up on a level with the van, or when it has steamed a distance equal to the length of the column; while by the old method, even supposing the speed of the van division to be instantaneously stopped and resumed, it had to steam over a space equal to the hypothenuse of a right-angled triangle, whose other sides each equalled the length of the column; but, of course, the speed is neither instantaneously stopped, nor is it entirely stopped at all. Its resumption is also a matter of time, the whole of which is so much additional dead loss, as compared with the former method.

Having thus briefly described what I mean by changing the formation by a flank movement, it only remains to repeat that it is the system selected, by which all changes of formation that can possibly be based on it are performed, and then to proceed to the consideration of the second class of movement on the list, described as "changing the class of a formation, by turning it on a pivot."

I have already described how the four general formations, that is, the one, two, three, and six columns, have their two "orders" and three "classes" respectively. Taking, for example, the second formation, or two columns, we can have them either in "line ahead" or "line "abreast," or on an "oblique line of bearing;" and it is easy to conceive that, taking one angle as a pivot, and keeping to the same course, the formation, if turned round, will pass through the different classes in succession. The detailed plan for doing this is merely an adaptation and extension of the old method of forming a "line abreast" from a "line ahead," but its principal use is now intended to be in making small changes in the line of bearing when it is not desirable to change the course. It is performed by one ship, selected according to her position, and the side to which the change is to be made, acting as a

pivot for the rest, by reducing her speed according to the change of bearing, while keeping a steady course, and each other ship under certain restrictions, circling round her "next towards the pivot" to her new bearing. Treated in this simple manner, this evolution is an exceedingly useful one. True it is, that if time is an object, it should only be employed for small changes of the bearing, leaving the larger ones to be done on the flanking system; but it gives a simple and easy means of doing that which, in the case of hurried evolutions, would constantly require to be done, viz., the making of small changes in the line of bearing of the columns.

We will now pass on to the third description of evolution, or "the "changing of the course of any formation by means of a flank move-"ment." In common with all the other flank movements, these are taken in substance from the French tactic book before mentioned, and the system is applied to all formations in line ahead or line abreast. They are intended to be employed when the course is to be changed more than four or five points, and are invaluable above these limits whenever it is desired to preserve the formation in its present succession; a great gain in time being attained, as compared with the old system.

Supposing a fleet to be formed in two or more columns, in line ahead or abreast, there are two methods of changing the course up to about four points. The first and most common is to wheel the formation on a pivot, or as it was called when, as formerly, it was only employed for lines ahead, to "alter the course in succession." The second, and I think in no way the inferior plan, though involving two signals, is to change the course together to the new course, throwing the formation on to oblique lines, and then, by the evolution just described for rectifying the line of bearing, wheeling it up on one of its angles as a pivot to its original class of formation. This latter method would also be the most advantageous when the change of course was more than twelve points, and an inversion of the order of the ships in line ahead, or of the columns in line abreast, was immaterial; but between about four and twelve points, the superior plan beyond all comparison, is that by the flank movement which I will now describe. Let us take a squadron in two columns in line ahead, steering north, and the course to be changed to south-east, by a flank movement to the left of the new course; the leader of the starboard column at once turns to a direction eight points to the left of the new course, followed by the ships of his column, while the leader of the port column leads his ships, in the first instance, on a line eight points to starboard of his present course, arranging his speed so as to strike in astern of the last ship of the starboard column. This is the moment at which the signal should be made for the assumption by the leaders of the new course itself "south-east;" but in case of delay, the leader of the port column must turn after the starboard column, and follow it. The two leaders may, therefore, be steering the new course in their proper relative positions, in the time from the commencement of the evolution, that it would take to steam the length of the column, and the whole of their respective columns may be formed in their wakes in the same time over again; and taking into consideration the

time lost in reducing and regaining the speed alone by any other method, it is the shortest possible evolution by which the change can be effected.

The fourth subject in order is that already now partly discussed—"changing the course of any formation, by wheeling it on a pivot." As applied to formations in line ahead, this evolution is called "altering "course in succession," and I shall here only proceed to describe it, as applied to those in line abreast. In the first place, let us take the case of the single column, or the "first formation." The extreme ship on the side to which the course is to be altered, turns to the new course, the other ships, at the same time turning towards her half the angle only that she has herself turned, each then keeping its distance from the next ship on the pivot side, steams up into the line abreast as fast as is consistent with not passing before the beam of such next ship, or beyond the "line produced" between her and the pivot. The speed of the ship acting as the pivot, must, of course, be reduced, in proportion to the extent of the change of course. This method as to the single column might be used with safety to the full extent of sixteen points; but above four or five, the flank movement system is so much to be preferred, that I should limit its use to four points at a time, thereby allowing it to be applied to the second, third, or fourth formations in line abreast, as well, in the following manner:—While the leading column is wheeling as described above, the other columns, with their original distance from the column ahead carefully preserved by their pivots, are forming up on a bearing from their pivot ships corresponding to the line of bearing of the new line abreast, so that when the first column having wheeled, the whole proceed at their former speed, each succeeding column will have merely to turn together to the new course as they arrive in the altered wake of their preceding column.

We now come to "exchanging the positions of any two adjacent "columns," and "inverting the order of the ships of any column." These are very old and simple evolutions, and beyond saying that safe means are provided for performing either, whether the columns are in line ahead, or line abreast, it will not be worth while here to discuss them.

Lastly, we come to the important point of "increasing or decreasing, "with the utmost rapidity, the distances between adjacent columns or "ships." As far as the columns themselves are concerned, it is necessary to provide, that unless a particular column is denoted, the extension or compression is to take place with respect to the centre of the formation; whether that position is filled by a column or not, except in the case when the formation chances to be on oblique lines, when an extension must be made from the column most astern, and the compression towards the column, furthest ahead. In the formations in line ahead, the moving columns are to turn out or in four points, and with oblique lines, in a proportion of one point less than four, to each two points of obliquity; in lines abreast, the moving columns attain their object, by regulating their speed alone.

The extension or closing of the distances between adjacent ships, to be rapidly performed, will demand considerable care and skill, espe-

cially in the case of formations in line ahead, which we will now consider. It is simply enough described. Any ship may be selected by which the column is to be regulated, and such ship is to continue exactly at her former speed; the other ships are to increase or decrease their speed together, or as nearly so as is consistent with waiting for the change of the speed signal of their next ship, towards which they are to close, or extend, by which they will not only be aware that such ship has commenced her evolution, but will also be informed of the extent of her alteration of speed by which to regulate their own. Easy as this is to describe, there is no doubt, that to close a large number of heavy ships on one point with precision and rapidity, is one of the most delicate manœuvres a fleet can be called on to perform. It will perhaps be found an easier evolution, when applied to columns on a line of bearing, other than a line ahead, when it should be performed as follows:—If closing the order, the most advanced ship of the formation would, as a matter of course, be that on which the column should be closed, and this ship should continue her course, the rest of the ships, at their former speed, should turn towards her an angle, equal to half the obliquity of the line of bearing, the regulator reducing her speed, so as to keep them during the movement on their former bearing; then each ship in succession, as she arrives at the proper distance, resumes her course and reduces her speed. If extending the order, the rearmost ship must be the regulator, and should the line of bearing be a line abreast, any ship may be selected.

Having thus explained briefly, though not enough so, I fear, for the patience of my hearers, the descriptions of evolution that seem to be required, it will be necessary to notice the arrangements by which it is proposed to render their actual execution sufficiently precise. At present it is always rather a matter of doubt and opinion, among other things, as to by what ship the formation is to be regulated, supposing the Admiral's ship to be stationed in the centre of a column, instead of at its extremity. A similar case of difficulty arises, when a column has to be conducted to a certain position with reference to another, and the senior Officer happens not to be at the head or flank of his column. There are many other cases of difficulty of this sort, of greater or less importance, but all of which interfere prejudicially in a corresponding degree with the free manœuvring of the fleet. I have therefore considered it absolutely necessary that some ship in the formation denoted solely by her position, should act as "regulator" for the whole fleet, and should the fleet be in more than one column, that the ship in a corresponding position in each other column, should be the one by which that column should be regulated; I call these ships respectively the "fleet and column regulators." In the formations in line ahead, and line abreast, it is considered advisable to be able to regulate the fleet from either side at will, and the "fleet regulator," therefore, in these formations, is the ship at the extreme "right front," or that at the extreme "left front," in accordance with whether the fleet is being manœuvred in direct or in reverse order. By this arrangement, during the flank movements, by which all changes among these classes of formation are effected, it becomes possible to regulate the fleet by its

"fleet and common regulators," during the actual progress of the movement; a point of essential importance. With regard to the second difficulty mooted, that is, the impossibility of the senior officer of a column, being able to give the precise courses required to his column, say to conduct it in line of bearing astern of another, unless in a certain position, it is provided that this shall be done by the "column regulators," under the correction of the senior Officer.

I will now say a few words as to the facilities afforded for the keeping in their station of the individual ships. Take the case of a ship in a longish line ahead, which by accident, or carelessness, has dropped, or shot ahead a little out of her station. Now, as at present each ship keeps her station solely with reference to her next ahead, this error on the part of the ship we are noticing, is felt by every ship astern of her, occasioning a great commotion, and a large extra expenditure of coal, the general result being that you rarely have the rear ships in anything like their stations. To remedy this, I should recommend that the next ahead should only be retained as a guide, so long as she was in her own station, which is to be ascertained by observing the distance in addition, of any of the near ships ahead of her that can be seen, so that a ship, whose steam, for instance, has accidentally got low, will be able to drop and again regain her station, the proper precautions being taken, without throwing the whole line out, as at present. In the case of a ship being actually unable to keep up, the fact of her making it known to the Admiral, and sheering out of the line, which she should immediately do, would be the signal, unless the speed of the fleet was at once reduced, for her place to be filled up by the ships concerned, without further directions.

It is of course impossible here to give more than a bare outline of the provisions on this and other subjects; but to those who have given any previous attention to the matter, they will, I hope, be sufficiently intelligible; and I will now, before concluding, make a few remarks on the general working of the system proposed, for instance as to what plan, if any, should be followed in originally placing the ships in the sub-divisions. It would, I think, be desirable that ships of a particular class should be kept together, but their particular arrangement must depend on circumstances; by keeping ships intended for ramming, or other especial purposes, in sub-divisions by themselves, much trouble and confusion might be expected to be avoided. Perhaps in default of other more important considerations, such as speed, the ships might be placed in their respective sub-divisions with reference to their turning powers, the fastest turners at one end, and the next fastest in succession; but this is, I think, a matter of small importance. A turning circle, of the smallest radius that all can turn on, should certainly be fixed on, and made obligatory on the "fleet regulator," while all others should go as near it as is consistent with, at the same time rectifying any discrepancies in, the position of their ships.

As to the formation in which it will be most advisable to keep fleets while cruising, I cannot help thinking that too little attention has been paid to the advantages offered by the line of bearing, or line abreast, at all events for day work. The difficult work of keeping a ship in

her station, it will be allowed by all, is the management of the speed. What has made this appear so difficult is, that when in line ahead—the order in which our ships are always kept—it is impossible, without very careful watching with the sextant, to detect those small beginnings in the variation of the distance, which it is so necessary to check. The difficulty is also increased, by the relative positions of the two ships, for as everybody knows, when looking at another ship right ahead, it is very rarely that something or other does not intervene, and partially obstruct the view. Now in a line abreast, or line of bearing, the management of the speed at once becomes the simplest part of the affair, and the chief difficulty is thrown on the management of the helm. With the form of compass card which I have proposed for use, by which all mental application of the error occasioned by local deviation is avoided, combined with common care in the matter of comparing the compasses of the fleet by simultaneous azimuths, or otherwise, this difficulty would I think be found to be reduced to a minimum.

Most people's experience of an oblique line of bearing, is unduly influenced by the difficulty they have found in keeping station, after wearing together in a squadron under sail, when it was blowing too hard to tack. No comparison, however, should rightly be made between this and the same formation in moderate weather, with ships under steam. By keeping the ships in a line abreast, or on an oblique line, all unnecessary risk would be avoided in case of a fall overboard; much coal would be saved in keeping station; the Admiral would see much more of his ships, and would be sure of having them close up in their places. At night the bearing might be diminished to three or two points from the fore and aft line, and the firing of a gun, or other signal, could cause the simultaneous sheer into the wake of the next ahead, requisite to avoid the chance of a collision with a passing ship.

When speaking of oblique lines, it would not be right to omit all notice of the "double lines of bearing," or the "angular formation." As these formations have hitherto been arranged and manœuvred, they have not I confess been particular favourites of mine. By the laws of their formation the order of the ships was so broken up, that no manœuvring was possible, until by an awkward process, impracticable if pressed by an enemy, you had got out of it as you got in; and now, although after a great deal of trouble we have succeeded in providing the means of manœuvring them, I do not feel inclined to say much more in their favour. Even for a retreat I see no great advantage; a pressing enemy would of course cluster on one side, and so render the other useless; and while it certainly keeps the ships concentrated, and so renders it more difficult to cut a part off, it renders them proportionably helpless, in case of an attack by rams.

Now as to the rams, the arm of naval warfare to which I attach the chief importance. In my opinion, the aim of all manœuvring, and preliminary practice with the guns, should be to get a fair opportunity for letting slip the rams. It may be very easy to prove how difficult it is for one ship to strike another, prepared for, and trying to avoid the blow, and in the case of single ships fighting on the open sea, I fully admit it; but with two squadrons bent on fighting, the opportunity is

certain to be given by one or the other, and victory will rest with that which best knows how to take advantage of the chance afforded it. An enemy may be caught embayed, rocks and shoals may prevent his free manœuvring, and then for the rams. Never mind their guns and armour, but have them low, unsinkable, quick turners, and of great speed. Keep them in the background until wanted, and depend upon it they will be found the most suitable engine for the work required.

I have now I think, touched on most of the important points connected with Naval Evolutions. An organization has been provided which will always preserve the fleet, or what may remain of it, in a state to be manœuvred so long as the ships can be collected together, admitting as it does of any extent of expansion or contraction. The means of changing from one formation to another have been carried to their fullest extent, while the mode provided for manœuvring in every possible way, and in the quickest manner, has been briefly explained. It will I am afraid appear that I am speaking in a very egotistical manner; but I will here repeat that I lay no claim to any special acquaintance with the subject, over those who may have given any attention to it; while the very system on which the whole of my observations are based, is that, I before mentioned as having been submitted to the Admiralty in 1863 by Admiral Sir William Martin. Any one however who has tried his hand at a paper of this description will, I feel sure, understand the difficulty there is, in assigning to each originator of a proposed improvement, his proper credit in the actual course of the description. The subject is a very old one, and most of the original proposers are to me unknown. But it will perhaps be considered sufficient to avow that with the work of Sir William Martin for a basis, I have taken the fullest advantage of all the previous writings on the matter that I could get at, as well as of the hints kindly furnished me by those officers of the Mediterranean Fleet, who were associated with me in practising the evolutions.

While thus admitting the very large share Sir William Martin had in the proposed system, I must fully exonerate him from all responsibility as to any extraneous views or opinions that I may have advanced in the course of this paper, and for which I must crave your kind indulgence.

The system thus worked out, has been so repeatedly under discussion, and as to its principal parts, so often put to the test, that perhaps a certain amount of confidence when speaking of it, may be excused. On public grounds it is certainly necessary to speak strongly, and I only wish that I could here place the subject in so strong a light, that more of my brother officers might be induced to open their eyes to its importance.

I am quite aware—and herein lies the great difficulty in pressing the matter forward—that with the present system, or at all events the system in force up to the spring of this year, a fleet may be very easily and safely cruised about. It may make a very fine show, and there may be plenty of evolutions, that with a little selection, it can well perform; but admitting all this, I am still afraid that it would be at the most imminent risk that any attempt would be made to put them to

the test in the presence of an enemy. Then, instead of being able to pick the evolutions which you know you can do, and which everybody knows, you will find a terrible pressure put upon you, and most of all for time; your rams are at the wrong end of your line, and you have no time to change them; or your ships are too extended, and you have no time to close them. At last, when hurriedly forced to adopt certain movements, you will find that these are the very evolutions that previously you had so studiously avoided. Somehow, the ships all seem to be going as if they did not know by which to guide themselves; each column slackens its speed, so as to regulate itself by another. Then you find, that smart as your signalmen are, the signals cannot be made quick enough; eventually the poop gets enveloped in flags, and the men look nearly as puzzled as you do. Then the ship leading seems to have forgotten to apply the point-and-a-half deviation that belongs to her compasses, or has done it the wrong way by mistake. You try more signals, but the end has come, time forbids further changes; in despair you whip up a final signal for close action, clap on full steam, and trust to luck and Providence.

Now, this may be a strong picture, but I have seen as curious scenes, without the extraordinary pressure of an enemy's fleet. I do not mean to assert, that such as I have described, is certain to be the result of an attempt to manœuvre an English fleet, but unless changes are made, it may be; and I do not mean to assert that the opposing fleet is always to be well and skilfully manœuvred; but again, it may be. Now, if by bad luck these two may be's should come together, I do not like to anticipate what the result would be. Judging, indeed, from the apathy one generally sees displayed on the subject, the consequences should not be serious, and I try to imagine that we should soon build more ships, and have another try for it. It is as well, however, if the opinions I express are found to be shared by those in whose experience, confidence should, if anywhere, be placed; that people in general should have some idea of what they have to expect.

A fleet, skilfully and rapidly manœuvred, would have as great an advantage over another in a less advanced state of preparation, as the superior organisation of the Prussian army gave them in their late war with Austria. A naval engagement, now-a-days, will not probably be a very long business; half an hour might see one fleet or the other pretty nearly demolished, and it would be suicidal that our fleets should be sent to their work wanting that confidence and promptitude which could so easily be acquired by practice. Eighteen or twenty gunboats, manned from the Channel fleet, and collected for a couple of months yearly at Portland, would, at a most trifling expense, soon effect an utter revolution in people's ideas generally on the subject of fleet manœuvring. The gunboats, I believe, the officers and men, certainly, are all ready, and the comparatively small expense of the coal required, should on no account be grudged.

How would armies be manœuvred, if officers and men were never instructed in anything besides the manual and platoon exercise, with an occasional march to and from their barracks? That is about the counterpart of the experience the Navy is permitted to obtain. What

Admiral ever has an opportunity of taking out twenty or thirty sail, and trying his hand at manœuvring them? I do not mean at jogging along at five or six knots, with the ships at great distances apart, and taking all the forenoon to change from two to three columns, or form a line abreast, but really to manœuvre as if going into action, with his ships at a high rate of speed.

At present, I am afraid, it must be confessed that we know very little about the matter; but it is to be hoped that a brighter day is dawning, and that our future leaders will yet be permitted to pick up their experience before the time of trial comes. My time, and the object I had in view, being now alike disposed of, I will conclude by thanking, most sincerely, the Chairman, and my hearers generally, for their kind attention.

The CHAIRMAN: We shall be glad to hear any observations that gentlemen may wish to make.

Vice-Admiral E. P. HALSTED: I think the main observation which any of us can well make is, how very much we are obliged for such a paper, and how very disqualified the greater portion of us are for really going into the true merits which belong to it. There is not a single shadow of doubt that none of us have any possible means, not even to the extent of gunboats, not even to the extent of ship's boats, of apprehending practically the manœuvring of a fleet. Therefore, truly we have to acknowledge with gratitude the attention which has been given to the subject, and the ability with which that has been done. As for discussing it, I am utterly incapable of doing it myself. I beg to offer my full meed of grateful thanks for what has been put before us. The paper contains evidence of having been prepared with great ability, as well as a great practical apprehension of the whole subject. Beyond that, at this present moment, I am quite prepared to sit down.

Captain W. HOUSTON STEWART, R.N., C.B.: I should like to make one or two remarks. While most fully agreeing with the observations of Admiral Halsted as to the little opportunity that Naval Officers have, of learning how to manœuvre their ships, I very much regret that there is not a much larger attendance of Naval Officers; and I still more regret that there are none of our directors or rulers here—those who might give the Officers of the present day the means of learning what they will one day find the want of, as Captain Pellew has put it in much abler and clearer language than I can do, at the conclusion of his most able lecture. I think it is a most valuable lecture, because Captain Pellew is thoroughly master of the subject. Being ignorant of it myself, I had the advantage of being a pupil of his for some time, when he was flag lieutenant under Admiral Sir William Martin. For two years he gave his entire attention to this system; studied the various systems of naval tactics of every nation in the world; and I believe that every system of manœuvres in these naval tactics was tried by him, either with dummies, or with pieces of wood representing boats. The system of manœuvres now before us is formed upon improvements made upon other systems of tactics. Having occupied the position which Captain Pellew did of flag lieutenant, he has had the opportunity of observing the great necessity there is for a system of tactics. Those outside the Navy, if there are any such present, would hardly believe, how helpless our ships are in the way of manœuvring. No one is to blame for it, because we really never have the opportunity. Captain Pellew says that he believes there is a brighter day dawning for us. I hope there is. I do hope that the subject will be brought before the British public, for they seem to be the masters at the present moment. Our Navy is without a system of tactics. I can only say, with reference to this system, that I have seen a party of twenty-four Officers, midshipmen and lieutenants, who had never seen a single manœuvre, assemble in a cabin, and in one hour the manœuvres were performed without the slightest mistake. That shows how simple the system is, and how easily it may be acquired.

Admiral RYDER: There are two or three remarks I should like to make; but I would much rather hear Captain Colomb speak first.

Commander COLOMB, R.N.: Admiral Ryder has been good enough to refer to me as being possibly capable of discussing the very able paper that we have heard read. Having a little knowledge of the difficulties that Captain Pellew spoke of in preparing a paper of this sort, it strikes me that Captain Pellew has shown a very great grasp of the subject, in the way in which he has addressed himself to it. I say that, because I know how difficult it is to draw up a paper of this kind. I think the service sustained a loss in the fact of Captain Pellew's health having broken down when the Admiralty awoke to the necessity for having a complete system of tactics before them. But Captain Pellew worked with me long enough to impress me very much with his practical knowledge of the subject; and I must say that I made the fullest use of it in what was done under the direction of the Admiralty. Sir William Martin's book was the only complete system of tactics which was before us when we had to draw up the new plan. Not only was it the only complete system, but it was the only system which was based upon a principle that could be carried out throughout. I suppose I break no confidence in a professional meeting in saying that by far the greater part—I may say nearly the whole—of the principle of that book has been adopted by the Committee which sat to investigate my work. I based the system of tactics almost entirely upon that book, making alterations in language here and there, and the Committee which sat to investigate the system adopted it almost throughout. I hope it will form a basis. Of course, it can hardly be said to be complete, because until it has really been practised by the fleet, it is impossible to say that any system can be complete. But I hope when the system has been practised, that it will be no longer possible to say that the Navy is without a system of tactics. Captain Pellew, I think, spoke very justly of a remark that we constantly hear: "Oh, fleet manœuvres and signals are not very important, because "the Admiral must arrange his plans beforehand." It has always struck me that it would be easy enough for the Admiral to arrange his plans completely beforehand could he know in what position he was going to meet the enemy's fleet. As it is impossible for him to tell this, I look upon it that the Admiral, who best understands his work at the present day, will trust more to his signals, and more to his capacity for manœuvring his fleet on the spur of the moment, than he will to any detailed plans before made; because we all know that any detailed plan of attack may be utterly thrown to the winds; if the fleet he means to attack does not happen to meet his attack in the way he expects it. When I say I believe the Admiral will trust to his signals on the spur of the moment, I do not mean that he will do that if the action has commenced. I think Captain Pellew spoke very justly in saying that the most important manœuvres take place before the commencement of the action. It is the mode in which you deliver your attack which gives you victory, and loses it for you; and that, I believe, is arranged before the action commences. I believe that the period of time during which fleets will now be under fire will be very short. We saw in the action off Lissa, as I remarked the other night, one of the changes coming over naval battles; that is, the fleets are more likely to pass through one another, engaging while they pass, to separate again, and reform for the attack. Therefore, if that is the true idea, the importance of evolutionary signals based upon a proper system, and the importance of securing that your fleet shall move from formation to formation in the quickest way, cannot be exaggerated. Captain Pellew spoke rather in disparagement of the necessity for ships turning upon the same circles. The necessity for such a thing was first pointed out by the Russian Admiral Boutakoff. I had the honour to carry out in the Channel squadron some experiments to test how far the necessity for similar circles was practically necessary—reversing the line, the fleet being in line ahead—altering the course 16 points, that is, to the opposite course, to the right or left—and we found that invariably, unless steps were taken to make ships turn on the same circle, the formation was utterly destroyed—not partially destroyed, but utterly destroyed; that there was no longer anything like a line. But when ships were taught to turn upon the circle of the ship which was least under steering power, that then the time lost was insignificant, but that the fleet, on arriving at the new course, 16 points from the old one, came

immediately into their places, without either difficulty or trouble. The difficulties that a modern fleet has to contend with in manœuvring in the face of the enemy are, that the rear may be the front, or the right the left, at any moment; and it is absolutely necessary to have your system of tactics arranged on such a plan that it will enable your rear to act as your van, the van as your rear, your right as your left, and *vice versâ*. The plan that has been adopted for the present is to establish a set of local terms. It is merely carrying out to a further extent what Admiral Martin has noted in his book in three or four places, and what Captain Pellew has spoken of again to-night—having a system of local terms referring to parts of the fleet; and in the evolutionary signals these local terms only are used. The "starboard column," for instance, will be the starboard column at the time the signal is made; the "port column" will be the port column at the time the signal is made; the "leading column" will be the leading column at the time, and the "rear column" the same. If the fleet alters its position the columns alter their names in in the same way. That is a plan that, as far as I can judge, will tend to simplicity in the arrangement. A very important matter also brought before us to-night is, how much better it is to manœuvre a fleet by the helm only than by the speed. If the speed of a fleet be uniform, as it ought to be, and the ships are accustomed to turn in the same circles, then a movement of the helm has a similar effect upon every ship; but if you come to alter the speed, you immediately alter the size of the circles in which the ships turn. Besides that, the helm is under the control of the Officer of the watch; the speed is only partially so; therefore, if you can manœuvre your fleets, and I think you can, by the use of the helm, you gain in simplicity. The question upon which ship fleets are to form is also a very important one, and I fully agree with most of what Captain Pellew has said upon that subject. It also shows us a point which I have before remarked upon—that is the difficulty of making the Admiral part of the formation. If you make the Admiral part of the formation, whatever the orders may be, they will insist upon making him, wherever he may be in the line, the pivot; whereas it constantly happens that the Admiral is not the pivot, and ought not to be the pivot. The consequence is, that ships are thrown out of their position by the double idea of the proper pivot, thinking at the same time that the Admiral is the pivot. I recollect once the Channel squadron being detained half an hour, because we had got the Admiral in rear of the line. We wanted the leader to go on, and we were fully half an hour making signals to her, which she could not understand, before we could go on. Such an instance happening in the face of an enemy might be fatal. As regards the oblique line of bearing, I agree with Captain Pellew that it is, or ought to be, a good cruising formation; but it is a formation very difficult to maintain accurately, and I think Captain Pellew agrees in that—it is not a good formation in action; it is too difficult to maintain accurately. But as a cruising formation, where it need not be very accurately kept, I think it is a very good one. As regards the angular formation, I agree with every point that Captain Pellew has stated throughout. Nearly the last point he adverted to was the question of rams. I must say I am very glad indeed to get a little support in that direction, because when I read my paper here the other night there were no remarks made upon the subject, except adverse to the idea of the ram being the chief weapon. The more I think of it, the more I go into the matter, the more satisfied am I that the ram is and will be the chief weapon. I do not say actual running down will be. It may be that some arrangement of the torpedo, such as I have heard adverted to, on the stem of a ship, may be the weapon; or it may be a very sharp spur, which, just touching a ship, will be able to destroy her. But whatever it be, I believe, the power of your engine driving your ship will give you the weapon that will be the most employed. In saying that, I do not mean to say that the ram will do the most destructive work; but I believe it will become the governing weapon of fleets, and that fleets will have to fight more with reference to avoiding the stroke of a ram than getting their guns to bear. It has been adverted to over and over again what a difficult thing it is to hit a ship. Now, I have had sent to me within the last two or three days a paper by Captain Randolph on the "Rules of the Road." I want to quote two remarks from it to show how, if it is difficult to hit a ship, it must be equally difficult, in a Naval

Officer's opinion, to keep out of the way of a ship, which, I presume, cuts the ground away from the first difficulty. He says, "How a ship is to keep out of the way of "another? This is exactly the difficulty for which we want a rule for the assistance "of people in charge of ships, especially the inexperienced, nervous, or suddenly "alarmed." Now, it has been said there is a natural impulse to move the helm somehow. I quote this merely to show that while Naval Officers persist in saying that it is a very difficult thing to run down a ship, they are at the same time asserting it is a very difficult thing to get out of a ship's way. I do not think Captain Pellew drew too strong a picture of the state of affairs at the conclusion of his lecture. I believe what he stated is literally and actually true. As regards the employment of the gun-boat squadron, it is one of those things which people have been recommending until they are tired of recommending; but I hope when we are all thoroughly tired, we shall at last see something of the gunboats.

Rear-Admiral A. P. RYDER: I will not detain you with more than a very few remarks. I have been looking forward to this Lecture with great interest, as Captain Pellew knows, and I am very glad to see Captain Colomb here. I know they are equally good authorities on the point, and that we should hear much that was interesting on the subject from both of them. There are one or two points I should like to allude to. One is the question of speed. In my own experience—but I believe some officers will differ from me as to whether it is a good practice to adopt—I found great assistance in maintaining a regular speed by always dictating to the engineer the *number of revolutions* he was to maintain. If you tell him, "Go on faster! go slower! slower still!" and so forth, you never arrive at any regularity. But if you tell him to go at 44 revolutions, for instance, he then knows what he has got to do. He is not content merely with opening or closing his throttle valve, but he is constantly ascertaining the speed of his engine, and, if his steam is high enough to enable him to follow your orders, he maintains the speed you dictate to him. This seems to me a wiser plan than to tell him to "go faster" or "slower," which I know is the common practice. I had the dial plate on deck and the dial plate in the engine room divided for revolutions, so that the order from the deck was constantly under the engineer's eye. Captain Pellew referred to the possibility of applying the deviation the wrong way, and of the ships being led away from the course. In the "Warrior" they adopted a practice which is always useful, and which would not lead to any error as long as ships were cruising in the same geographical position; that is, to have a compass with all the points altered for the deviation, so that they should be absolutely accurate. This is of great importance when fleets are cruising and no great likelihood of changing their geographical position, and I should think it would be advisable to have one compass-card so altered in each ship. It is evident that no error can possibly occur as long as the deviation does not alter. I think it would be a useful thing for an iron-clad fleet, if they had their compasses adjusted in that way, viz., one card permanently altered for each cruising ground; be it the Bay of Biscay or the Mediterranean, there would be no great difficulty in either place. Both Captain Pellew and Captain Colomb have alluded to the advantage that officers would have, if they had the opportunity afforded them of witnessing evolutions. I imagine all officers who anticipate or hope to serve in the fleet, and who are now on half-pay, would be willing and desirous, if they had the opportunity, of witnessing the new evolutions. Whether the Channel fleet, which is shortly to proceed to sea, is going to practice the evolutions which, I believe, have all been prepared, and are in print, I am not sufficiently in the secrets of the Admiralty to know. But I can tell any Naval Officers who are here present, and who might wish to witness those evolutions, the amount of success, or rather the non-success of an application I made to the Admiralty, to know whether they would allow some small vessel to accompany the fleet, with half-pay officers on board (who certainly are not likely to go to the Bay of Biscay with any expectation of comfort or pleasure.) The "Vivid," or any other vessel of her class, would answer the purpose. I hoped that they would allow such a vessel to accompany the fleet, and enable half-pay officers to witness the new evolutions, and learn, as far as they could learn on half-pay, what they could have no other opportunity of learning. The answer I received was, that their Lordships had no intention of sending any such vessel with the fleet.

Lieutenant A. GILMORE, R.N.: I think there is no reason why the Admiral, at noon, should not telegraph to the rest of the fleet the deviation of the compass of his ship, each ship would then know what the deviation of the Admiral's ship was, and what course she was steering, and there would be no difficulty whatever in keeping the same course that she did. I would also remark, that in the present day when ships differ so much in speed, and in force as regards guns, and the disposition of guns, that the system of naval tactics is very difficult to bring to any issue. I fancy that rams will be kept as a reserve; that the ships of the line will go into the conflict, and the rams will be kept in reserve to go and ram the enemy that is engaged with their friend. As regards the regulation of the speed of the ship by the engines, all the ships should be regulated by the speed of the Admiral. There would be no difficulty whatever in the officer of the watch, or the captain of the ship, after half an hour, knowing the relative speed of the vessels, and sending word down to the engineer, "So many revolutions!" instead of "half power!" or "full power!" Then the ships would be regulated to the same speed, and the same amount of helm would influence each. As I said just now, it is most difficult at present to introduce any system of naval tactics from a line of battle, when ships all differ in speed and effect; one going 14 knots, another 12, another 8. There are no two vessels in the Navy built on the same principle, or calculated to effect the same purpose. One carries a 12-ton gun, another an 8-ton gun, another a 6, another a 4; no two are the same. We all know that the speed of a squadron or fleet is the speed of the smallest vessel. You must either go ahead, and leave her in the lurch, to be attacked and taken, or you must slacken the speed of your whole squadron to her speed. I think that fact is overlooked in all our naval constructions. In the last few years, Mr. Reed has tried to put undue steam-pressure into ships to drive them ahead. The effect must be that those vessels, after a very short time, will become overstrained and unseaworthy. Whereas, if vessels were built on one principle, and contented to attain a due rate of speed, naval evolutions would be much more simple, because things would be equal. At the same time, a few vessels might be attached to each fleet, as rams, to go in at high speed with powerful prows, when an enemy is in line attacking our fleet, and to ram our opponents. I think, when our Channel fleet, as at present, consists of about seven vessels, some of one speed, and some of another; some with one size of guns, and some with another, that Captain Pellew's system is all thrown away; and until a more uniform practice of building, &c., is introduced, he will never be able to see his system adopted.

Captain HEATH, R.N., C.B.: I am one of those who are rather afraid of too much tactics; and I suggested to Captain Pellew whether, by sub-dividing into four instead of into six, his object of avoiding the difficulty of turning over three columns into two, will not be equally attained, whilst my object of simplicity will also be attained. I agree with those who began the discussion, in saying that it is impossible really to discuss the important paper which Captain Pellew has put before us, for want of preparation on the subject. But I must say that I think the old signal book is quite competent to do a great deal that is wanted to be done—"Alter course together!" "Alter course in succession!" "Preserve a certain line of bearing! a compass line of bearing!" With respect to columns—"Preserve a certain compass line of bearing!" Those old signals will do a very great deal which you are now attempting to do, by more intricate rules. It must always be remembered that these rules are variable, and intended to be put in practice only in order of sailing; that in sight of an enemy, your first object is to form your order of battle. Once your order of battle is formed, you must never forget Nelson's rule, "No captain can do very wrong who puts his ship alongside his enemy."

Captain FREMANTLE, R.N.: I did not intend to say anything at all, but after what has fallen from the last gentleman, having had some experience in the manœuvring of fleets under the old system in the Channel fleet, I think it right to state what my experience is. Under the old system, with the old signal-book, it was extremely difficult to manœuvre fleets at all, especially under steam; and when we got the fleets into some particular formations, which were easiest and best understood, they would not be the formations which we should more particularly have required in case of action. I may specially mention that which Captain Pellew has referred to,

namely, the angular formation. Certainly, when fleets are formed in two lines of bearing, it requires several formations to get them into their lines of battle, or lines of squadron sailing. Captain Colomb said something about signals with regard to columns. As far as I understand him, it would be simply a question of flags; the flags would not always refer to the same division; that is, the flags would be changed as the divisions changed. That is to say, if I may use an old illustration, the letter M would not always be the starboard division. I do not think anything could lead us into a greater mistake than that; because I found, in manœuvring fleets, it was a great advantage that letter M always meant the starboard division, namely, certain ships belonging to a special section of the fleet. That was the only safe guide you had.

Captain COLOMB: Perhaps I may be allowed to make one remark in answer to what has been said. We have employed two distinct modes of naming divisions, or squadrons. The squadron flags addressing them, always address that particular division, no matter what its particular position may be. But when the divisions are spoken of in the signal, then their local signification is given. So you have two distinct methods of speaking to the divisions; they are first, second, third, and they are also named the starboard division, the port division, and so on. I may also read the second paragraph from Captain Randolph's book, to which I called attention:—

"The rule of giving way may be a very good rule for the open road, but it is no "guide at the moment of impending danger, if not an embarrassment. I can con- "ceive it highly probable, that if three people were on the bridge, one would advise "starboarding, another porting, and the third stopping." This is from an officer who has very gravely considered the subject, not with reference to rams, but with reference to getting out of the way of ships. They are, I think, some of the most important words that I have seen written.

Lieutenant A. GILMORE: I would also remark upon the great difference there is in the classes of vessels. In the old time of war we had the three-decker and the two-decker, the three-deckers leading the van, and the two-deckers forming the second line. Now, we have a great variety of vessels, and if our fleet went into action it could not adhere to the order of battle. The Admiral would have to form a different arrangement. It would be useless for the "Warrior" to attack a two-gun turret vessel, or for the "Wivern" to fall foul of such a ship as the "Magenta." The fleet would have to be arranged in such a way as that the ships composing it shall be able to attack vessels of a corresponding class.

Captain HOUSTON STEWART: May I be allowed to make one other remark? I was much struck with what Admiral Ryder said about the revolutions of the engine. I dare say Captain Pellew remembers that we had to introduce that practice in the Mediterranean fleet. I happened to be Flag Captain, and had charge of the "Marlborough." I found I could make nothing of it, until we introduced this system of directing the number of revolutions, and the captains of the other ships, with great success, adopted it. I dare say Captain Pellew remembers how, after a few days, the ships manœuvred almost as one ship. Captain Pellew will, in his reply perhaps, refer to the method of using boats for the instruction of Officers. We older hands, though we may hope once more to smell salt water, are right, I think, in considering what measures should be taken for bringing up the young officers, so that those who are now coming forward in the Service may learn to manœuvre ships as they now learn navigation, and every other useful science. I would, therefore, ask Captain Pellew, in his reply, to give his opinion as to the use of boats for instruction; because I was really struck with the great utility and the facility of giving instruction to the officers, as Sir William Martin did in the Mediterranean, by means of boats. I am sure that those midshipmen and officers who took any part in the manœuvres, directly any signal was made to their ship, would have known what was to be done; they would not have had the slightest necessity for thinking what they were to do, or where they were to go. The only thing they had to do was to manœuvre their ship, but how to manœuvre her, they had learned before. I cannot see that there would be any expense or trouble in employing boats for instruction. Captain Colomb has told us that the new signal-book is coming out. I am sure it will be a very valuable one. But why should not the Captains of the ships in the Channel squadron learn

manœuvring with boats as we did in the Mediterranean. We saw every manœuvre that a fleet could perform :—"Line ahead!" "Line abreast!" &c., without the slightest mistake, and after very little trouble. An officer might learn this system of tactics from boats alone.

Captain F. A. CAMPBELL, R.N.: I can bear testimony to the truth of what has just fallen from Captain Stewart. It may be thought that the practice is not kept up. It is kept up in the squadron, at least it was a year ago. After Sir William Martin's time, the boats generally assembled two or three times a week, under different Captains. It was, no doubt, an excellent school for young officers; the midshipmen, lieutenants, and captains themselves learned a great deal from it. When under steam, if a signal was made, they knew at once what they had to do, from perpetual practice in Valetta and elsewhere, under oars.

Captain HEATH: It fully bears out what I said of the fears I have, of too much science being introduced into this practical business. My first experience in learning fleet manœuvres was also in boats, thirty years ago But if the captains have to go into their boats to learn the existing manœuvres, why, you will have to rely in future upon captains who have pulled about with your midshipmen in their boats. I mean to say that it is an argument for keeping the thing as simple as you possibly can. If the old, simple rules are not known to the captains, how are the new and more intricate rules to be known to them?

Captain FREMANTLE: I do not think the old rules were very simple. They were rather complicated; they were obliged to be complicated on account of the sails, and of those that were put in afterwards for use under steam—namely, beginning from 0 up to 100; I think there were 30 or 40 of them. I only speak from memory; there were very few, and, if I may presume to say so, I do not think they were particularly well put together.

Captain PELLEW: Captain Stewart, in a very flattering manner, has asked me to give my opinion about the use of boats for the purpose of teaching the manœuvring of the fleet. You learn a great deal from boats; a great deal in the way of practical experience. Of course it was easier in the Mediterranean, where you have no tides, and generally calm weather, than it would be in our harbours at home; though I have no doubt we could get the time in the summer to do it.

The CHAIRMAN: I think we all row in the same boat. With few exceptions we do not know much about the subject, because we have not had the opportunity of learning it. I am sorry that with all our zeal we have such a small attendance of Naval Officers to listen to Captain Pellew's able and interesting paper. I compliment him upon the very able manner in which, in a small compass, he has told us a very great deal.

LECTURE.

Friday, April 12th, 1867.

MAJOR GENERAL SIR VINCENT EYRE, K.C.S.I., C.B., R.A., in the Chair.

THE UMBEYLA CAMPAIGN.

By Captain FOSBERY, V.C.,* Her Majesty's Bengal Staff Corps.

The CHAIRMAN: I have much pleasure in introducing to you Captain Fosbery, who will read us a paper on the Umbeyla Campaign, in which he bore so distinguished a part as to earn the decoration of the Victoria Cross. Although a subject of four or five years' standing, I have no doubt it will be found to contain some novel features most interesting to the present audience.

Captain FOSBERY: I should have hesitated to accept the kind and flattering invitation given me to address you to-day, had it not been for some considerations which I will, if you please, briefly lay before you.

My hesitation was caused by distrust in my own power of telling the story of this campaign as it should be told. I felt that in the short space of an hour it would be most difficult to fill in those details which give life and reality to the fossil remains of a despatch or blue book, and general interest to figures, only to be exhumed from those difficult strata by some unusually patient explorer.

On the other hand, I reflected that the story contained many episodes of interest to every soldier; and that were it told, however imperfectly, some valuable political and military lessons might yet be drawn from it; some more wide-spread interest not unworthily excited in scenes where have been gained the experiences, formed the reputations, or dug the graves of some of England's ablest soldiers; some attention, drawn perhaps also to considerations which, unknown or unheeded *now*, may by-and-bye force themselves (and terribly, too, should we be unprepared) on the attention of the entire nation.

India for England, as Algeria for France, has been aptly called the nursery of soldiers, but whilst France has kept her whole army

* Now Major Fosbery.—ED.

instructed in the lessons learned in that nursery by a portion of it, we have neglected on our part to do the like. Algeria gave France her Zouaves and Spahies; her military rifle was invented for its conquest; the tentes d'abri were devised to lighten the equipment of her flying columns; and an admirable system of mountain artillery and military train, so organised as to unite rapidity of movement with efficiency in action. A hundred other military improvements, thus originated, have pervaded her entire army to its great and lasting benefit.

Few French officers of standing are ignorant of the tactics to be adopted in an Arab campaign, or of the methods of maintaining, moving, and fighting with success a column in that difficult country. Their artillery, commissariat, and transport also are always ready for instant and protracted service.

Comparatively few English officers know what Indian mountain fighting means; the remainder, when brought face to face with a brave, numerous, and formidable enemy, on ground very different from the valleys of Aldershot, or the plains where so many of our triumphs have been won, are apt to find the ordinary regulations, manuals, and drill books less than what is necessary for immediate success. English courage and English resources eventually win the day, but both courage and resources are often wasted in the winning. True, we have men such as Neville Chamberlain, Reynel Taylor, Wilde, Vaughan, Green, Probyn, Keyes, Brownlow, and others, whose very names are a terror to the tribes with whom we are continually in contact; but they are so, not merely because they are brilliant soldiers or diplomatists, but because they possess a special knowledge, not possessed by the rest of our Services; an experience, too, which unhappily dies with them.

It may be objected that the Umbeyla campaign was a little war—one of those little wars we occasionally wage, which attracted the attention of not one man in a hundred in England; and further, that the soldiers present were sufficient for it. To this I would venture to reply, that ere its conclusion, the movement of troops in support extended to Meerut, more than 400 miles from the scene of action; that it caused a most grave excitement in Asiatic minds from Calcutta to Cabul, and beyond it; and that towards the end of December, 1863, on this account alone, there were no less than 25,000 men in motion west of the Jhelum, whilst 36 British officers and nearly 1,000 men, were killed or wounded, during the course of the operations. Besides this, in a country ruled by the sword, no war can be a *little* one whose result will certainly decide the attitude of the warlike tribes outside a frontier of hundreds of miles in length, and possibly excite to action the tens of thousands of secretly hostile fanatics within it; both issues hung on the conduct of this Umbeyla war, and account for the anxieties of some of the highest authorities in India. Nor was it successfully concluded, but by the determined attitude of Sir Neville Chamberlain, who (like Nelson) would *not* be recalled; of Sir Hugh Rose, who, approving his determination, vigorously supported him by a most rapid and effective concentration of troops; and finally, by the decisive action of Sir William Denison, who on his arrival, steadied the councils of the administration, and in his concise and able minute, pointed out clearly

enough, the disastrous results of hesitation, failure, or retreat. But if this war really involved such great results as it may be shown it did; if similar expeditions are to be again undertaken (on a continually increasing scale), and should it not be impossible that we may become eventually engaged in very extensive operations in these same mountains for the very maintenance of our Indian supremacy; then, it cannot but be well to draw attention to points, the careful consideration of which, may materially influence our success. On these grounds, therefore, I venture to deliver this lecture, asking you to bear with its many imperfections.

After a brief description of the *locale* of the war, its causes, and the enemy against whom it was fought, I propose to consider its plan, conduct, and results, and conclude by drawing attention to such considerations as seem most worthy of attention.

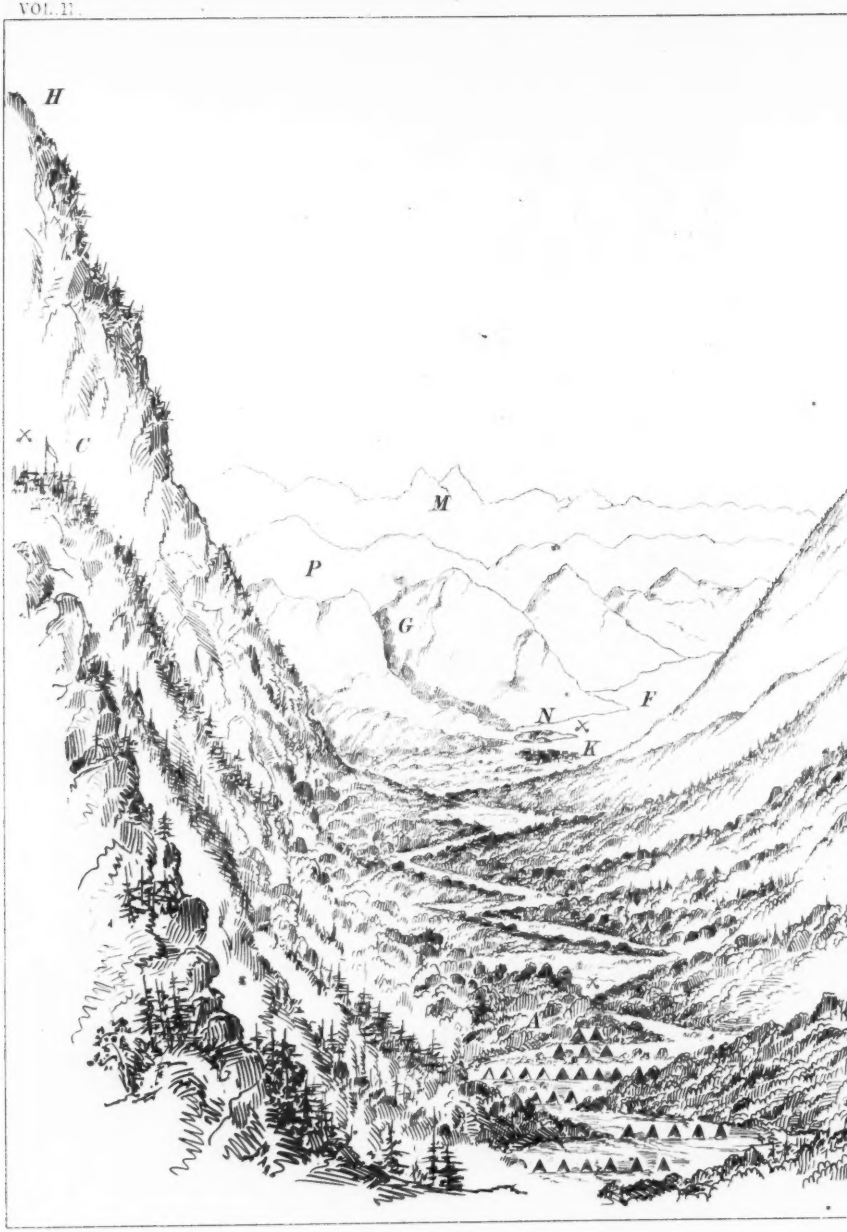
In doing this, I will if you will permit me, here and there quote from descriptions of my own, written at the time, and repeat occasionally such opinions then expressed, as have not needed modifications by the light of knowledge subsequently obtained.

I must further express my great obligations to Colonel Adye's able *résumé*, entitled Sittana, and to the sketches, photographs, and plans which he has kindly permitted me to copy.

The ostensible cause of this war was the insolent conduct of a body of Hindostanee Mussulmen, fanatics of the Wahabee sect, under chiefs named Moolvie Abdoola and Syud Mobaruck Shah. This body of men, recruited from lower Bengal, and further strengthened by the presence of rebel sepoys, who had escaped their just chastisement at the time of the great mutiny, had taken up their residence at Mulkah, a town on one of the lower spurs of the Mahabun mountain, or "hill of the mighty forest," as its name stands translated into English. This colony, whose earlier history is well told in Cunningham's history of the Sikhs, until the year 1858, had been placed at Sittana, within sight of our frontier (the opposite bank of the Indus). From this point they crossed the river by night, harried our villages, drove off our cattle, and carried away the wealthiest men for ransom into the fastnesses of the hill. This became unendurable, and in that year a force was placed under the command of Sir Sidney Cotton for their chastisement.

Crossing the river, he captured and burned the village, and bound by treaty the surrounding tribes, to prevent the return of the colony who had, with few exceptions, escaped. They soon built a new town at Mulkah, in the heart of the Mahabun, and for a time remained quiet. But it was well known to our frontier men, that the behaviour of this colony, placed beyond our borders, was but the manifestation of the sentiments of the fanatics within it, by whose contributions it was maintained, and by whose orders it acted; and the Umballa State trials of 1864 showed conclusively how widely-spread was the conspiracy, how perfect was the organisation, and how well prepared the treason of those who planted this thorn in our side.

It might have been well to have let them live as a political barometer, had this been the only point in question—two thousand enemies, more or less, being of little consequence to our Indian Army. But when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A. Genl Chamberlain's 1st Position.
B. " " 2nd "
C. Eagles Nest
D. Keye's Position Standard Picket
E. Crag Picket. 4 times assaulted
F. Chumla Valley
G. Boneyr Hills & Pass.
H. Gorco Mountain
I. Coraical Hill twice stormed
K. Village of Umbeyla, burnt Decr 16th
L. Village of Lalloo burnt Decr 15
M. Snowy Range
N. Scene of Gen Garvocks action of 16th Decr
O. Water Picket
P. Boneyr Hills

J. Jobbins

they returned from their town of Mulkah to Sittana, and commenced plundering on our territories, drilling on the one side of the Indus, and firing at our troops on the other, it became evident that something must be done.

This conduct did not only mean that some few fanatics were getting troublesome, but it meant also that the tribes on our border were becoming careless of treaty, and defiant of our power, and might any day join in the depredations, and share the plunder of the lawless colony, all participations in whose actions, however, they as yet disavowed. It also meant that a disaffection was spreading within our own territories, and as we had not then the clue to the soul of the question, it became necessary to apply an adequate punishment to the body represented by this Sittana colony, and act on mind, as has been so often done before, by dealing with matter.

The question then arose, how were they to be reached and effectively punished, placed as they were in the immediate neighbourhood of powerful tribes, whom it was undesirable to provoke, and with whom they might take sanctuary and so escape. A glance at the plan of the position they occupied will show the difficulties under which we laboured.

Mulkah, their settlement, was most strongly situated in a cup, or hollow, high on one of the spurs of the great Mahabun mountain.

This mountain, by some supposed to be the Hill Aornos, which cost Alexander the Great more than two years of fighting and a large proportion of his army, is situated in a bend of the Indus, isolated from the remainder of the chain of hills, on the one side by the Chumla valley, and on the other by the plains of the Eusofzaie, our proposed base of operations. Could it be possible then, without serious resistance, to gain the line of the Chumla Valley holding the Eusofzaie, as we did, on the one hand, and the fords of the Indus on the other, the colony, and, as we hoped, the war, would be confined to this corner; and to the attitude assumed by its tribes, the Koodookehl and Judoons, which would almost certainly be hostile, the force to be sent against them could afford to be indifferent.

Not so as to the other tribes, however, who were warlike, numerous, and formidable, the best swordsmen and the best marksmen on the frontier and but few amongst whom had, from past experience, learned to respect our military power, or dreamed of the extent of our resources. With the Boneyr tribe, indeed, we had been always on good terms, and with them our line of route would bring us most nearly in contact. But it soon became known that the colony, hearing of what was probably in store for them, had sent out emissaries amongst the tribes for the purpose of arousing the fanaticism, always latent in the mind of every Mahomedan, however lax his religion, and the fears and jealousies of a naturally suspicious and jealous race. There was an excitement amongst them which might possibly be allayed, but on the other hand, easily increased into active hostility. Fanaticism, moreover, is one of the most capricious as well as the most formidable of human motives.

The problem, therefore, was to reach the Chumla Valley with as

little offence to any one as possible, having done which, every hour's march would remove us further and further from those to whom it was inexpedient that offence should be given. There were two ways of doing this, either by the Durrun pass or that of Umbeyla. The use of the Durrun pass, from the nature of the country, would entail more labour on the troops. That of the Umbeyla offered a greater offence to the tribes with whom we desired to remain on good terms, for it was the one communication between the key of the Boneyr country and the plains below, and the Goroo Mountain, which rose from the stream at the bottom of the pass, to a height of 6,000 feet on its northern side was exclusively theirs, while the pass itself they considered exclusively their own also. That we had foreseen this difficulty, was proved by the means taken to overcome, or rather *get round* it.

The force to be employed, consisted of some 5,600 men of all arms, including the 71st Highlanders, 101st Bengal Fusiliers, half battery of Royal Artillery, under Captain Griffin, the Huzara and Peshawur Mountain Train guns, 100 sabres of Colonel Probyn's famous regiment of Horse, 100 of the Guide Cavalry, 4 regiments of Punjaub Infantry, 1 of Goorkahs, and the 32nd Bengal Native Infantry. It assembled at Nowakilla, in the Eusofzaie, on the 12th of October, 1863, and General Sir N. Chamberlain assumed the command on the 17th.

The greatest secrecy was observed, not as to its objects, but as to the means to be taken for attaining them.

The Durrun Pass had been the one selected by Sir Sidney Cotton for an expedition into the Mahabun in the year 1858. It was but six miles distant from the camp at Nowakilla, and through the tribes prepared for defence at both points, it was natural that they should suppose we would select this one in preference to the other.

In order to confirm them in this opinion, a small force under Major, now Colonel, Keyes was sent to encamp opposite its mouth, and this manœuvre was instantly followed by a concentration of the enemy, who began stockading the pass, and showed themselves in large numbers on the hills flanking it. On the night of the 19th October, General Chamberlain broke up his camp; and transmitting orders to Colonel Keyes to join him at Pernouli, and a proclamation to the Boneyr tribe, assuring them of our friendly intentions towards themselves, he marched on Roortum Bazaar, *en route* for Umbeyla.

His march was well contrived, a description of it therefore may not be uninteresting. A night march is always an uncertain and trying thing; but by forethought and good management, the troubles of this were reduced to a minimum; still it had its disadvantages. In night marching, there is always, first of all, the difficulty of getting clear of camp. In India it is a scene of most extraordinary, and at first apparently hopeless confusion. The groaning of camels, the unparliamentary language of men who break their shins against tent pegs, or tumble over ropes, the shouts of those unfortunates who have lost their regiments, horses, or servants in the darkness, mixed up with the blows of mallets on the tent pegs, and words of command from every possible direction, make a din that must be heard to be appreciated; even after the *fall in* and when every man is in his place,

the guides are generally missing, and on this occasion were so, long enough to deserve the fervent blessings of the entire force, which they duly received as they went to the front.

At last the advance sounded, Field Officers mounted, the British subaltern threw away his cheroot and fell in, and the long column was off, steering to the N.N.E., through a dark and cloudless night, and feeling its way at the rate of some two and three-quarter miles an hour. The night was cold, and the wind from the hills bitter and piercing. The road, a village track at best, gradually became merged in fields and cultivation. But presently, at half a mile distance, a bright light, like a star, flashed out, and gradually grew larger and brighter, and on this the march was directed. As we advanced, a second and a third appeared at regular distances. The first soon resolved itself into a blazing fire of dry thorns, sheltered by a mat screen from the wind and the view of the hills. Round it were seated some four or five gipsy-looking men. These rose as the force came up, and, shaking back their long hair, gazed in undisguised wonder at the great moving cloud of dust, out of which flashed into their circle of light, now the long teams and bright appointments of the heavy field battery, now the red coats and white helmets of the British line, the Khaki uniforms of the frontier force, or the blue turbans and glittering lance points of Probyn's horse. Then, as the last of the column passed, they turned and dashed out the fire, whilst another and another springing up beyond, defined the distant road, and guided the force from light to light till the morning. Here and there a deep sandy ravine occurred, when strong working parties of Europeans, with drag ropes, ran the guns down and up the steep banks, and kept all going. At last came the chill wind that always precedes the first streak of day, so well known to every one who has marched by night in India; then a greyish light, and the first note of some wild bird from the jungle, and then the jagged hill line began to show out, high against the eastern sky, like a ruined wall, seemingly close to us. Presently the day broke, the force mounted a long slope, and halted in echelon of regiments on high ground above Roostum Bazaar, having travelled about eleven and a half miles since starting. After a hasty meal and deliberate pipe, we were off again, leaving the round towers and mud walls of Roostum to the left, and changing direction more to the eastward, we pushed through the lower grounds towards the base of the hills. These soon began to close in on either hand. A glance to the right showed us the baggage of Keyes' column winding through an opening in the lower range, and looking picturesque enough in the blue misty air of the early morning. At last we entered a long, broad valley, which narrowed gradually as we proceeded, till, after crossing a small clear stream at Surkhowa, we were fairly in the mouth of the Umbeyla Pass.

The pass proved to be nine miles in length, and was for the last portion of it, intricate and difficult. Nor was it possible to maintain much military order, except at the very slowest pace. Here was seen a mule being dug out of a crevice by sappers, while H. M. Infantry halted and swore at the delay: there a jamb of mountain train ammunition

or stores, the beasts kicking and screaming twenty deep in an angle of the water. Now a few inexperienced men would push forward in a likely direction on the flanks, and being brought up by impenetrable jungle, or the edge of a precipice, return growling. Then a block would occur to the front, when the entire force sat down to drink cold water or smoke the pipe of patience. Fortunately there were none to hinder. Had the enemy occupied in any force any one of the formidable defensive positions which the pass offered, there might have been trouble; for once a false alarm of fighting, to the front, showed how difficult it would have been to have united the troops in any part of the pass for attack or resistance. But the brunt of what little fighting took place, had been borne by the advanced column, who had crowned the heights on both sides of the gorge, and proceeded according to the established rules of mountain warfare.

As the hills bounding the road were frequently intersected at right angles by almost impassable ravines, it was at first sight a puzzle to us how this was managed so quickly and efficiently as to keep the leading column well in advance of those that followed, and the pass at the same time entirely free for them.

The process was pretty and soldierlike: two of the leading companies were pushed up on either flank, the enemy if disposed to be troublesome, got a shell from the mountain train, then the infantry charged, and cleared them out, and that pair of hills was safe. Coming down at their leisure, the men fell in in rear of the column, whilst two more companies ascended the next hills in their turn and covered the advance, which was steady and well conducted, as might have been expected from its leaders. At last the force reached and occupied the most formidable gorge of the pass, at that point whence its streams flow two different ways, to the rear to join the Cabul River, to the front to traverse the Chumla Valley and fall into the Indus under the dark shadows of the black mountain. Then however the march ended. neither guns, commissariat, or baggage having arrived; nor was all fully up until four days afterwards. Those four days were sufficient to complete the combinations and assemble the forces of the tribes whom the route chosen, had exasperated, and the two miles of that march unfinished on the 21st of October, remained so until the 16th of December, two months later.

Pending however the arrival of the baggage, on the 22nd of October, General Chamberlain sent out a party of cavalry under Colonel Probyn, to reconnoitre in the plains beyond, sappers to improve the road by which the force was to reach them, and a regiment of infantry to occupy the pass in front during both operations. The cavalry avoiding the village of Umbeyla, which practically though not geographically belonged to Boneyr, took the southern side of the plain and proceeded as far as Kagah without resistance, finding the road practicable for troops of all arms. On their way they perceived large bodies of the tribes assembled at the Boneyr pass, who however professed their intentions to be peaceable unless an attempt should be made to enter their pass or country.

The time occupied in the reconnaissance however was sufficient to

change their resolutions, and on the return of the cavalry, Colonel Probyn found himself opposed by a considerable body of the enemy, posted in strong ground to dispute his return. He therefore on their commencing to fire, at once charged them vigorously, cutting his way through them and went up to camp. The sappers and the 20th Native Infantry then became engaged, and Colonel Brownlow was followed in the dark and difficult ravine, by a large body of the enemy, who not only fired continually, but closed with the rear guard, sword in hand, at every moment.

Two miles of this work brought him to the pickets of the camp, and these in their turn becoming engaged, a heavy night attack followed, blood was shed on both sides, and we were at once committed to a war with the tribes, of which no one could guess the extent. To have advanced now would have been to abandon the line of communication by the Umbeyla pass to the mercy of the Boneyr tribe. And to take the line of the Chumla Valley after abandoning it, would have been to place the force between the Boneyr tribe and their allies on the one hand, and the tribes of the Mahabun on the other, with an unknown country, whose physical difficulties had already been found to be formidable enough, increased ten-fold by the hostility of these tribes in rear.

The Umbeyla pass was said by those who had seen *both*, to be more formidable than that terrible Khyber pass so disastrous to the army of Cabul; the Mahabun mountain was absolutely unknown. Under these circumstances General Chamberlain decided, and doubtless most wisely, to maintain his communications with his base, and suffering himself to be attacked where he stood, to give the tribes a proof of our power, which should convince them of the helplessness of long withstanding it. He accordingly took up a position on the crest of the pass, and pushed up outposts on his flanks on either side, giving orders that these posts should be strengthened by stockades or breastworks as far as possible. He also ordered up the troops necessary for keeping open his communication, and placing his guns in position, remained for a time on the defensive.

The situation was truly a peculiar one. The small portion of the pass occupied by the force (about 200 yards in width at that point), and filled with huge rocks in every direction, was dominated on both sides by almost precipitous hills; 1,500 feet up, the distance between them was only 800 yards, which gives a fair idea of their sharp angle of ascent.

From below, the ridges immediately commanding the camp were plainly visible, and on these it was proposed at first to establish outposts, but on reaching these points, it was discovered that they in their turn were dominated by strong positions further up in the hills, and it thus became necessary to push post after post, into the mountains one either hand until the process was only stopped at the Eagle's Nest, on the left flank, and the Crag picket on the right by the impossibility of adequately relieving or supporting the troops at greater distances. As it was, no relief from below could reach the Crag picket in less than 45 minutes, nor the Eagle's Nest in less than one hour from the time of leaving the camp below, and as these posts were

invisible from thence, assistance when required must be sent for, which practically doubled the distance.

Roads too had to be made to connect these posts and breastworks for their defence, and the work entailed great fatigue on a large proportion of the force.

But whilst the inefficiency of his carriage, together with the unforseen difficulties of the pass had so far thrown out the General's calculations, as to place him in an almost purely defensive position, the dangers of that position were unfortunately augmented by the nature of the defences constructed. When timber, earth, or stone is available in large quantities, it ought not to be difficult on favourable ground to throw up such a defence as might be held against any enemy unprovided with artillery.

The examples we have seen of Bootaneese bamboo forts, Burmese stockades, or New Zealand pahs, show that the merest savages know how to do this, and to do it well. We however, as a rule, I fear, neglect such precautions, and over-confident in our arms and courage, often content ourselves by placing the smallest and most unscientific obstacles between ourselves and our enemies. The slight dry stone walls at first built here, barely covered their defenders from the enemy's fire, in some cases the troops inside could scarcely fire over them, in others the enemy could flank defence on the one hand, and defilade on the other were almost entirely neglected.

These little posts were too often constructed rather with regard to the immediate presence of materials and natural form of the ground, than to its defence, and the garrisons who occupied them suffered accordingly. The Eagle's Nest picket lost half its garrison from the enemy's fire during four hours from these causes alone, and the Crag picket, though strongly garrisoned, was twice taken by the enemy, simply because no flanking fire on any one of its faces was provided for. The moment such fire was obtained by building of a trifling outwork, the enemy ceased at once to attempt it.

We are strong, well armed, and well disciplined, and knowing ourselves to be so, we are too apt to forget that fanaticism, the *elan* of a body of men who are content to die for one good blow at their enemy, will often give them for a moment a superiority over the best troops in the world.

It has often been asked why do tyrants so rarely die by the hand of the assassin. The answer is simply because no conspirator can be found, notwithstanding all professions to the contrary, who will undertake to fire the shot or plant the dagger, with the clear understanding that his death, without hope of escape, must follow the next instant. All hope to get off somehow, and the act of looking back mars the enterprise.

But amongst the fanatics of India you will find hundreds of men who will band themselves together with the very purpose and intention of gaining a death at your hands, so long as they can kill you. They accept and triumph in the death itself, without *arrière pensée* of any kind, and thus become enemies not to be despised by the most skilful and bravest soldiers.

Of this character were some of those who opposed the force under General Chamberlain, and to their reckless bravery are to be attributed many of the casualties that took place. In some instances they actually clutched the muzzles of the cannon, cutting desperately at the gunners, in others they threw themselves fearlessly at the slight breastworks, leaping, sword in hand, amongst their defenders, and either becoming the leaders of a successful assault, or dying the glorious death they fairly earned.

On the 26th of October, the enemy attempted the extreme right of camp, but were detected in the act by Colonel Keyes, who soon after daylight took the initiative, and drove them along the crest of the ridge from one position to another, until they finally took post at a place known afterwards as the Conical Hill. As they were in great force and he had but 200 men, he halted on the ridge opposite, at a distance of about 650 yards, and sent to camp for reinforcements. These, consisting of mountain train guns, European marksmen, and a Goorkah regiment, owing to the distance, did not arrive until nearly two o'clock.

The range of the enemy's position having been then ascertained by means of rifle shell, and fuzes cut and adjusted accordingly, marksmen were placed in position, and given their distance; the guns masked by sections moving in front of them, were dragged by hand into position. The sections then suddenly wheeled back, and the guns and marksmen opened at once on the top of the hill. The effect was almost instantaneous; the enemy completely taken by surprise at the weight and accuracy of the fire so suddenly brought to bear on them, began to waver, when Colonel Keyes, at the head of his regiment, dashed across the plain, stormed the position, and drove the enemy pell-mell in the direction of Laloo, capturing a standard, and cutting them up in the operation and several of the force, then returned to camp.

The men of Colonel Keyes' regiment, the old Cokes Rifles, so distinguished at Delhi, performed a sort of war dance round the captured standard, to the music of the sirinai, an instrument in sound much resembling the bagpipe, the Europeans loudly cheering them as they marched past. An officer paused to look at this performance, and admire the fine physique and warlike bearing of these wild soldiers. Ah, said another, "you are astonished at this; that's only a standard they have there. At Delhi these Pathans used to do the same thing, but they did it round the heads of their enemies."

Though beaten however, the enemy were not discouraged; they had arranged for a simultaneous attack on both flanks of the camp, but somehow the Boneyr people failed to keep to their engagement, which gave great offence to their allies. The next day, however, the former determined to redeem their pledge, and threatened the Eagle's Nest and pickets on the Goroo mountain in great force. The General, therefore, reinforced these posts, placing the left defences under Colonel Vaughan. High above the Eagle's Nest picket placed on the extreme right of the line of defence stood a large sunga or breastwork of stone, which commanded that work, whilst its entire face was subject to enfilade. To its left and at a lower level was a line of troops, posted amongst broken ground, whose left flank rested

on a knoll, on which were placed the mountain train guns. Presently the enemy gave a great shout, and waving their swords and standards, rushed down to the attack, their marksmen dropping into every place of shelter, and firing rapidly to cover the advance of the sword and spear men, who came up to the attack with great boldness; but between the base of the slope and the rocks on which the picket was placed, was a little plain, some 80 yards in width, and here they became fully exposed to the fire from the work, which was so close, accurate, and deadly, that four hours' fighting left them foiled, with a loss of some 300 killed or wounded. The European marksmen alone are said to have put *hors de combat* 180 men, losing 7 of their own number, whilst an English officer and 40 other men lay killed or wounded inside the post, being nearly half the number originally employed for its defence.

This action necessitated a far stronger occupation of the slopes of the Goroo Mountain, and still further weakened the force in the valley below. Breastworks were now built across the ravine at the two extremities of the camp, batteries constructed, and guns placed in position for their defence, and stone walls run up for a considerable distance into the hills on either bank, to cover the troops employed.

On the following day the Boneyr men came in under a flag of truce, asking permission to carry off their dead. They did not seem humbled or beaten: frankly admitted their defeat, but, pointing towards the great mountain, said there were many warriors there to take the place of those they were now carrying for sepulture to the burial-places of their fathers. Certain, however, it was, that some of their principal men had fallen in the assault, and there were vacancies at their council fires, which the tribe could ill afford. They now established a series of small posts on inaccessible points of the hill, outside the defences, and searched out with an accurate and constant fire the greatest part of the camp, causing several casualties, and specially annoying Captain Griffin's battery. To this fire it was extremely difficult to reply with effect, and the marksmen of the European regiments were constantly employed in this service.

On the 30th, having previously received large accessions of force, with whom came also the Ackhoond of Swat, a spiritual leader, whose position as regards these tribes is compared, by Sir N. Chamberlain, to that of the Pope of Rome towards Catholic countries, they planned a simultaneous attack on the right, left, and centre of the position. That on the left, or Eagle's Nest, was abandoned on the failure of the other two, which were, however, delivered with great energy and considerable judgment.

The Crag picket, which you see in the sketch here, had hitherto been only occupied by Colonel Keyes (whose position is shown below) as a post of observation, and on the night of the 29th was occupied by twelve men only. The enemy, however, seeing its importance and the command which its possession would give them, approached it towards morning, overpowered and drove out the feeble garrison, and occupied the summit of the rocks with some 250 men, the remainder waiting on the ridges in the neighbourhood to take advantage of the confusion which their fire must produce at daylight in the posts below.

The nine survivors of the picket, however, retreated only as far as the rocks at the base of the Crag itself, and, opening fire on the enemy above, who were busy strengthening their position, called loudly for support.

Colonel Keyes at once answered this appeal. Taking with him an officer and ten of his own men, he proceeded to join them, directing his adjutant, Lieutenant Pitcher, to bring up more men as fast as they could be got together.

By dawn he had with him some seventy-five men at the foot of the rocks, on whom the enemy poured a continuous and heavy fire, hurling down at the same time huge stones, which caused several severe hurts.

As soon as it was light enough to distinguish friend from foe, and his left flank was covered by Colonel Brownlow's corps, who moved out into the ravine below, he divided his force into two parties, gave the order to fix swords, and sounded the charge. The Pathans gave a wild shout of "Allah! Allah!" (in the name of God) and rushed at the Crag, scrambling like cats from rock to rock, by ways through which but one man could pass at a time, in the face of a hot fire and heavy shower of rocks and stones.

This daunted some of the men, and Lieutenant Pitcher who was leading at the time being stunned by a heavy stone, but *two officers*, Colonel Keyes and another, and about twenty-five men, arrived at the summit where they became engaged in an exciting hand-to-hand conflict. Colonel Keyes was severely wounded, but the place was won. The nature of the struggle may be judged of from the fact that sixty of the enemy's killed and wounded were left on the ground, three standards captured, and the rest of their force was so much discouraged by the action as to retire from that flank altogether. Meantime an attack had been made on the front of the camp, which was repulsed by the 71st and 101st regiments, aided by the fire of the guns in position, and a dashing charge made by the Goorkahs, in which, however, the latter suffered severely. Their dead, when brought in, were found to have been shockingly mutilated by the enemy, and from this time it came to be an understood thing, that in this war, quarter would neither be asked nor granted on either side.

A story is told of an officer who, seeing a stir upon the hill side amongst the European troops sent out to the scene of an action fought two days before, and a large group assembled about some object on the ground, ascended a rock above them to learn the cause. A curious sight presented itself. In the centre lay the mutilated body of a slain comrade, and at its head stood a non-commissioned officer with a Testament in his hand. Man after man came up, and to each was administered a solemn oath that from that day out they would neither save nor spare, but pay that debt to the uttermost.

That oath was afterwards well kept, and many a tall Pathan recreant sepoy and fanatic Moslem read his fate in the stern eyes and pale compressed lips of those who had sworn to give no mercy.

The enemy's attacks now became intermittent, and for a curious reason. Before dying, it behoves every good Mussulman to repeat a short prayer, failing which his soul is exposed to vexatious delays

and inconveniences on its road to paradise. An exemption to this rule is, however, permitted should his death take place on his Sabbath, our Friday.

In their wars with one another, the sword or small matchlock ball was seldom so instantly fatal as to preclude the performance of this rite. Our bullets, shrapnel shot, and shell, were, however, on trial, found to be less considerate, and many a pious Mussulman pined in the cold, outside that heaven he had died to win. There was but one remedy, and in future they fought their more considerable actions on their Sabbath only.

This arrangement proved welcome to the force. The change of base was effected, Pemouli being selected as the depôt in place of Roostum Bazaar, and the Pass of Kanpoor made practicable for the communication, to replace that of Umbeyla, which it was proposed to abandon. Preparations also were made for transferring the whole force from the ravine itself and the heights of the Goroo Mountain, to a position on the south side of the pass at the head of this road, and communications were pushed on towards the plain in advance, for the future use of the force.

To do this with safety, strong covering parties were sent out to cover the working parties and sappers employed. A Friday intervening, however, during the continuance of these operations, these parties placed at a considerable distance from camp, from which also they were separated by deep and all but impassable ravines, became surrounded by the enemy, and only regained the position with the loss of their leader, Major Harding, who, refusing to leave his wounded to the mercy of the enemy, paid for his chivalry with his life, of Ensign Murray, of the 71st, and Lieutenant Dougal, of the 79th, who were both killed, besides 34 others killed, and 37 wounded. Amongst the latter were Oliphant, of the Goorkahs, a man of a name famous in India, and the gallant Battye, of the Guides, brother of that Battye who like him was struck down in the fore front of battle, and whose latest words when dying were "Dulce et decorum est pro patria mori." His conduct, and that of other officers on the summit of the hill, alone saved the covering parties from a more serious disaster; and it was not until late at night that all returned to camp. Thence could be seen bodies of the enemy with torches, following on the line of the retreat, slaying the wounded, and plundering the dead. Stragglers now and then arrived; and one man, a private of the 71st, who had been stunned by a heavy fall amongst the rocks, did not arrive until dawn on the following morning, having escaped, by what seems almost a miracle, the parties of the enemy who patrolled the sides of the hills.

This was the first success which the enemy were able to obtain, and it encouraged them proportionably. After this, however, there was again a pause, during which the enemy received reinforcements from Bajour and the more distant tribes, and their parades on the level ground near Umbeyla became imposing by their strength, and picturesque, from the numbers of gaily coloured silk standards which they carried, and the costumes of the different mountain men.

On the night of the 12th of November they attacked the Crag picket, which had been greatly enlarged, and now contained 160 men; and from nine o'clock in the evening until three in the morning, to the number of some 3,000 men, used every effort to force the post, Colonel Brownlow, who had before so successfully defended the Eagle's Nest, was, however, in command, and judging by the attitude of the enemy that an attack was imminent, further strengthened the position, during the last few hours of daylight, by every means in his power. He threw up traverses to intercept the heavy enfilade fire from the opposite ridge, 400 yards distant, and by dusk had every man in his place, and prepared for the coming attack. Presently Captain Hughes' guns from the position in rear, threw a couple of shell into the enemy's watch fires, which they at once quitted, and descended into the ravine below. Here they were sheltered from the fire of the work, and nothing but a dull murmur told the defenders that a numerous enemy, bent on attack, lay within 80 yards of their slight defences.

Now and then could be heard some impatient chief marshalling his followers for attack, and, last of all, the deep voices of the Moolahs, or priests, who blessed their "enfants perdus," and promised the joys of paradise to those about to die. Then a pause, and then arose a shrill, wild cry, so wild and shrill that for a moment no one recognized it as the war cry of the Moslem "Allah! Allah!" but it was instantly taken up by 3,000 deep voices, and, with a wild shout, their heavy column quitted its cover and rushed at the breastwork.

Colonel Brownlow waited their approach and then suddenly poured into the mass a fire so close and deadly, that nothing living could face it, and perforce they retired; in half an hour they returned to the attack, and were repulsed as before. Again and again they attempted to storm, and still the fire of the works mowed them down as they came to close quarters. At last making a most determined attack on both sides of the weakest angle of the post at once, hurling large stones on its defenders, whom they confused and overwhelmed by the suddenness and vigour of this new mode of attack, they got at the wall itself, pulled it down, threw the stones on the defenders within and were masters of the corner.

Many men of the garrison commenced to retreat, but Colonel Brownlow, calling for volunteers and getting but four or five, rushed at the place, turned the invaders out, rebuilt the wall, and held it for the remainder of the night. The guns also from their position, 250 yards in rear, guided, as to range and direction, by voice from the post, opened fire, throwing shell over the top of the rock into the ravine beyond and doing good service, and though attack after attack followed, Colonel Brownlow maintained his position with success, until the morning.

At three the fighting ceased, both sides being weary, and the enemy having suffered considerable loss. Then a strange incident occurred. One of the enemy taking shelter under a rock within 20 yards of the post, called to the garrison in Pathan patois to know if they were not tired of all this noise and gunpowder—for his own part he freely

confessed he was—to this a reply was made that they were quite ready to go on. "But," said he, "don't you think singing is better than fighting, sit quiet for a little and I will sing"—and without further preface he began singing in song after song, the wild strains of love and war, which stir the hearts of these mountaineers. The troops on our own side, many of them recruited from these very hills, took up the chorus and from the deep ravine, where his friends lay, came a chorus louder than ours, and now and then a sound of applause which plainly showed how numerous and how near they were. He was addressed from the post and complimented on his singing and bravery, and asked if he would not take service with the English, who would duly estimate both qualities; to this he replied, "we have quarrelled and not yet settled our quarrel, when that is done I will consider"—and firing his matchlock at the post in defiance, he dived into the ravine, and was no more seen.

Colonel Brownlow's men who had been 48 hours on continuous duty were relieved soon after daybreak by Captain Davidson and men of the 1st Punjaub Native Infantry. The enemy almost instantly made a new attempt, stormed the post before the men were fairly in position, killing Davidson, who refused to leave his post and died as a soldier should, and a large number of the new garrison with him. The place had therefore to be retaken, at the point of the bayonet, by the 101st Bengal Fusiliers, under Colonel Salusbury. But pending their arrival, the advance of the enemy was stopped by the fire of mountain train guns, and the heroic behaviour of three or four officers, notably Lieutenants Pitcher and Young, who collecting a handful of men charged them so vigorously as to save the main pickets, and give time for the arrival of reinforcements.

Colonel Keyes, though still suffering severely from his wound, showed the greatest coolness, and held the breastworks successfully, at a time when everything was in the utmost confusion, when there were but few good men available for defence, and a mass of camp followers, panic-struck soldiers, and baggage, blocking in their flight, the only road to the camp below. Colonel Salusbury, as soon as he arrived, at once formed his regiment for attack and stormed the Crag, heading the assault, which was made with that dash for which his regiment, as well as himself, have long been celebrated.

Slight skirmishing followed this affair, but on the 18th of November the arrangements for the movement having been completed, General Chamberlain decided on retiring his left flank and concentrating his whole force in rear of what was before called the "Right advanced pickets."

Drawing off by degrees his men and material from the slopes of the Goroo mountain by 10 A.M., on the morning of the 18th of November, his force, having performed a most delicate and difficult movement, had occupied, without molestation, a strong position on the southern side of the pass, and had changed their base of operations, line of communication, and military position at one and the same time. But here the enemy interfered. This instance, were there no other, would conclusively shew the justice of the opinions of Sir N. Cham-

berlain, and those who supported him, in his refusal to retreat, not only on account of the impolicy, but also on account of the danger involved. The enemy mistook this change of position for retreat, and thereupon organized one of the most formidable attacks delivered during the whole course of the operations.

They followed up the retirement in great force to the lower pickets of the new position, drove out their defenders, and, but for the determined resistance of the troops, would have entered the camp itself. Here were killed Smith, of the 71st; Chapman, the Adjutant of the 101st; Murphy, of 14th Native Infantry, and Lieutenant Jones, a volunteer from the 79th. Lieutenant Chapman, knowing his wound to be mortal, begged, but in vain, the retiring troops to assist Captain Smith, and leave him to his fate. Both were, however, killed, and their bodies not recovered until the 21st.

On the 20th the Crag picket, then garrisoned by two companies of European troops, was again taken by the enemy. Two Officers were killed, together with a large number of their men; and Major Delafosse, one of the two survivors of the Cawnpore Massacre, in vain displayed the greatest bravery, in the hope of rallying the men, and still holding it.

The post was retaken by the 71st Highlanders, under Colonel Hope, who, moving out from the breastwork, advanced, in face of a tremendous fire, steadily, and without a single break, to the summit, to which two roads had by this time been constructed. This they did without the smallest appearance of hurry, their pace being regulated by Colonel Hope himself, who, briefly saying, "71st, you have to take "that post, and to follow me," led them up the hill, and was the first man to enter the work. Here, however, he was unfortunately severely wounded, as was General Chamberlain, who accompanied the assault, and the force was thus deprived of the services of its two Senior Officers.

This was the last great attack delivered by the enemy. On this day, too, the late Major Hugh James, Commissioner of Peshawur, arrived in camp whilst the fight at the Crag was going on, having just returned from England. He was supposed to know more of the characteristics, relationships, and interior policy of the tribes, than any other man who had occupied the same position. At the same time, General Chamberlain received a telegram authorizing him to abandon his position and retire on Pemouli, but this, though wounded severely, and in spite of the heavy losses the force had sustained, he refused to do. Major James supported him in this determination, representing to the Government that though matters were very serious, retreat could only make them worse, and set himself to sow disunion amongst the tribes pending the arrival of reinforcements. This he did in a simple but most ingenious manner, which shows the suspicious nature of these men, as well as their simplicity. He had with him a body of native levies, who formed a means of communication between ourselves and the enemy. Some of these levies he assembled in front of his tent, and, producing a huge bundle of letters, told them they must take them to the enemy's camp.

Then, seeming to reconsider the question, he took out a certain number, saying, Ah! well; I won't write to so and so; he has so little influence; or so and so, for his followers are so few; and making some disparaging remark about each chief named, he burnt the letters addressed to them, to the number of about one-half. The rest he charged the spies to give to the remaining chiefs, with a request to take them away from the council fire, and read them quietly.

His orders were carried out, and whilst one-half were away reading their letters, the others, jealous of their distinction, cross-questioned the spies, and discovered from them the remarks which had been made on themselves by the Commissioner. On the return of the other chiefs, they were called on to show their letters, and these were found to contain nothing beyond a few ordinary compliments. "Ah!" said the others, "that won't do. Where's the letter promising you money for "deserting our cause?" These, of course, never existed, and the poor men had none to show; but the neglected chiefs could not be persuaded to believe it, and such mutual mistrust was engendered that the Boneyr tribe never again united to attack us; so that the attack which entailed the fall of the Crag picket, proved to be their last.

The force now, with but small interruption, awaited its reinforcements, the enemy during the same time also receiving great accessions of strength. Indeed, the excitement spread along the whole border, and attacks were made on us at other points by tribes who had long been neutral or friendly. On the reinforcements fully arriving, and the force reaching a strength of 9,000 men, General Garvoch, who succeeded Sir Neville Chamberlain when the latter was disabled by his wound, commenced a forward movement, in anticipation of the enemy's proposed attack on camp, of which he had received intelligence.

Moving out with two brigades, he drove them along the ridges of the southern range, and took the Conical Hill by storm, as also the village of Laloo, which he burned. He then bivouacked for the night. In pursuance of their original plan, however, large bodies of the enemy had entered the valley, and learning how large a number of troops had quitted the camp, made a strong and well sustained attack on the advanced positions. These, however, under Colonels Brownlow and Keyes, resisted all their efforts, and mortars having been brought into play for the first time, searched out with their fire the ravines which had before sheltered their parties, almost within stone throw of our works; and Colonel Keyes at length, by a brilliant charge, drove them pell-mell into the valley below, whence they did not return. On the 16th the force descended from the hill, taking and burning the village of Umbeyla, and offered battle to the enemy in face of the very key of their country. Colonel Probyn had led his sabres down from the heights, nearly 2,000 feet, into the plains by paths supposed to be barely practicable for mules, and menaced any of the enemy who might venture into the open. Their cavalry prudently concealed themselves in the broken ground, and saved their lives thereby. Captain Griffin, who had got his half battery down carrying the guns and carriages on elephants, now horsed it, and passing the village at a gallop, took up a position on the right, and opened fire with shell and shrapnel. The enemy

gradually retired, and two regiments thrown out as skirmishers pressed their movement. Presently, however, a horde of Ghazees, or fanatics, 250 strong, came out of a ravine which had hitherto concealed them, and in an instant dashed at the line, cutting right and left, and causing some confusion. The regiments were driven back by the mere force of the onset, almost as far as the supports which Colonel Turner had echeloned in their rear. The enemy, who witnessed the conflict from the pass above, already began to descend the pass with loud shouts. The retirement, however, lasted only a moment, and, closing with the attacking party, the Pioneer regiments exterminated them to the last man.

This action closed the campaign. The Boneyr tribe submitted, and asked for orders. Their allies had now fled, and they were informed by the Commissioner that, to prove their good faith, they must send a force to Mulkah, and destroy it. They gave hostages for their performance of this compact, which they religiously fulfilled, several British officers accompanying them, to see the work done. Amongst these was Colonel Adye, and the drawing before you is a copy of a sketch of his, taken on the spot, and showing a portion of the town. The troops, with the exception of a small column sent to coerce some of the smaller tribes, who had not yet submitted, now returned to their cantonments.

The main points to which I think the story calls attention are the following:—1st. As it was by the deficiencies of carriage hastily collected, and organized on no regular system, that the force was delayed long enough to permit of the combinations of the tribes, it will be seen that for successful hill expeditions, excessive lightness of equipment and efficiency of transport should be insisted on. 2nd. Considering the delays which the bringing up of reinforcements entailed, no force should attempt to enter these hills without a strong reserve close at hand. 3rd. Mountain-train guns of greater length of range and accuracy, are required. The 12-pound mountain-train howitzers did good service, but the 3-pounder guns comparatively little, being inaccurate at any distance, and their light projectiles being useless against the smallest dry stone wall. Batteries of European artillery, having Armstrong or Whitworth guns, of not more than 2½ cwt., each, and of long ranges, might with advantage be organized for frontier service.

4th. A body of marksmen, carrying long range rifles, and trained, organized, and equipped for the arduous work of the hills, would form a most valuable adjunct to any force destined to operate there. The mountain men are themselves first-rate marksmen, seldom throw away a shot, and respect an enemy for the like qualities; they despise him for the want of them. The marksmen of Her Majesty's regiments employed during the campaign, did excellent service, but not being trained to the work, suffered severely from its harassing nature, and from wearing dress and accoutrements designed for the parade-ground, or at all events for tolerably level country. 5th. We learn that no care expended on the field works, however small, was thrown away; whilst the want of it was often disastrous in its results. No officer should be ignorant of the necessary precautions to be taken in tracing a work, nor the height and proportions of his breastwork.

6th. Abatis, if constructed at all, should be solidly made and judiciously placed, and traverses thrown up where necessary, and all this, not under the enemy's fire, but as a part of the plan of the work during its original construction. Then, as the front or flanks of any position taken up amongst such mountains as these, is sure to have deep ravines in its immediate neighbourhood, which will always serve as *places d'armes* to the enemy, mortars should be provided to dislodge them from situations in which neither musketry nor artillery fire will touch them. It continually happened during the Umbeyla war that such ravines formed the cover from which their most formidable assaults were delivered, and until the last few days the force had no means of dealing with them until the attack had actually commenced. Hand grenades, too, and some means of throwing a strong light in the front of the positions during the night attacks, of which many took place, would have been of most essential service.

The Americans have perfected a system of this kind; they also, instead of abatis, used telegraph wire, tied from tree to tree, which had the effect of stopping a charge, and detaining the enemy for a few moments under fire; this was exactly what was required here. Strong wire, such as is used in the telegraphs in India, is also the very material required for supporting and binding together an abatis not exposed to the fire of artillery.

The Americans applied artificial light for both attack and defence in a most ingenious manner. The light was so arranged that a screen left either the defenders or attacking party in complete darkness, whilst throwing a strong reflection on their enemies, and some simple contrivance for producing and directing light in such a country as this would be of the greatest advantage.

The hand-grenades, improvised of soda-water bottles filled with powder, and having a small piece of port fire stuck in the neck, were wholly useless. Few men had the courage to light them, and the throwing them over the breastworks, in their hurry to be rid of them, extinguished the port fire ere it was well lighted; thus of all that were prepared, not one did any service. The fuze of a hand-grenade cannot be so extinguished, and a supply of them would have been most useful.

At the commencement of this lecture I alluded to the necessity that might some day arise for extensive operations in these hills, for which it would be ill to be unprepared. In vindication of this allusion, allow me to draw your attention to the map before you, which indicates both the nominal frontier of Russia, and her actual advance beyond it. This may not be an immediate menace to our Indian possessions, but I do not hesitate to affirm that the matter needs immediate and earnest attention, wise forethought, and careful preparation. It has been of late years the fashion to deride what used to be called Russo-phobia—a feeling which in old times led to the occupation of Cabul, and our connexion with the Dooranee Empire.

Our statesmen now advocate a policy of non-intervention in central Asia, and the consequence is, that whilst Russia is advancing steadily to the line of the Syr Daria—Alexander's base of operations for the con-

quest of India—we are unwilling to give even moral support to those who are opposing to this progress, a gallant, though unfortunately useless, resistance.

But whilst in Europe a policy of non-intervention may be understood, and possibly even respected, in Asia, it is quite unintelligible to the native mind, and is but too often supposed to be dictated either by weakness or fear. We now find that the envoys from Bokhara, who during a whole year in vain solicited our aid, even in the shape of one or two British officers to sit at their councils (could no more be done for them), are at present at Moscow; and the negociations on which they are engaged, will doubtless lead to a further extension of Russian prestige and the Russian frontier.

That Russia keeps a keen eye to India, notwithstanding what may be said to the contrary, may be gathered from the fact, that her spies penetrated the entire country during the mutiny, and that letters written in Russian narrating every circumstance that occurred were captured at the time. Where, as in Asia, *prestige* strengthens almost incalculably the hands of the ruling power, her gain must be our loss, and her successes, even though not directly against ourselves, may lead to most serious trouble by the encouragement they will give to the lawless men of our border.

Major James suggested, and Colonel Adye strongly recommended, a change of policy towards these men, and that instead of vainly attempting to coerce them by force, we should rather endeavour to win them to our side by measures of kindness and conciliation. This may or may not be possible, but either way, the surest guarantee of peace, is a perfect readiness for war.

Time will not permit my further pursuing this subject, but should I have succeeded in drawing the attention of others to one or two points which I so sincerely believe to require it, this lecture will have fulfilled its object, and the story of the Umbeyla Campaign not been told in vain.

Ladies and Gentlemen, I thank you for your kind attention.

The CHAIRMAN: I am sure that all present will agree with me, that we have heard a most admirable lecture upon a most important and interesting subject. I think few will be disposed to deny that such papers have very great value to all Englishmen, and that the present paper may be said to have a special value, when, as Captain Fosbery has pointed out, our northern frontier is likely to become the scene of still more important military operations than any that have hitherto occurred in that region. Such life-like sketches as we have heard from one who has himself borne a part in the active operations of the campaign, must always be of great interest. Certainly, it may be considered as one of the advantages of this Institution, that it presents opportunities for explaining to Englishmen that which at all times is so difficult of apprehension. Nothing, perhaps, is more difficult than for English people to understand the occurrences which take place from time to time in so distant a region as India, and which exercise a very important influence upon our national history. I am sure the present

company will support me in offering our cordial thanks to the Lecturer. As Colonel Adye is present, and has himself entered largely into the subject of this lecture, perhaps he will favour us with a few observations.

Colonel ADYE, C.B., R.A.: I should like to explain for a moment with regard to the position of the Russians in Central Asia. If you look at an old map of Russia, of 40 years ago, you will find that the Russian frontier was far north of the Jaxartes, whereas we know what has happened since the Crimean war, that they have taken the line along the Mustau mountains. They have got steamers on the Caspian; they have sunk a line of wells across the desert; and they have got steamers on the sea of Aral. They established themselves, first of all, on the Jaxartes, with forts down that river; therefore, that became their line. In the meantime they also advanced from Semipolatinsk. In the year 1844 they came down this line, and we know now that they have got their outposts on the crest of the Mustau mountains. We have at the present moment frequent telegrams from St. Petersburg of fighting in Bokhara. They are doing on the Oxus what they did a few years ago on the Jaxartes, and I believe they have got as far as Charjooe. They are, apparently, taking a line down the Oxus. Our advanced post is at Peshawur; there is, therefore, now nothing between the Russians and ourselves but Affghanistan, of which Cabul is the capital. What appears to me is this, that we should cultivate, if possible, the friendship of the Affghans, because they are not only a very warlike and fine race of men, but they really hold our natural frontiers: that is to say, they hold the great line of the Hindoo Koosh mountains. At the present moment, we have a very bad and dangerous frontier; we are in the air. I do not say we should advance, because we should get into interminable war with these people; but I do think, if we could succeed in gaining their friendship and confidence, we should have in that, a great barrier against the Russians. I do not say that the latter are enemies, but they may be enemies; at all events we have this powerful nation coming down towards us. We have already advanced our frontier 1,600 miles to Peshawur, and I think everybody will see that these Affghan mountains form the natural frontier for the English.

The CHAIRMAN: The meeting is very much gratified by what Colonel Adye has said. I trust that Colonel Adye may be induced to give a lecture upon the subject. In the present critical state of matters, such a lecture would be of very great advantage, not only to members of this Institution, but to the British public.

LECTURE.

Friday, June 7th, 1867.

MAJOR-GENERAL THE HON. JAMES LINDSAY, Vice-President, in the Chair.

THE CONSTITUTION, COMPOSITION, AND RECRUITING OF THE FRENCH ARMY.

By MAJOR-GENERAL G. BALFOUR, C.B., R.A.

BEFORE entering on the subject on which I have the honour to address you, I am anxious to explain the nature and extent of my enquiries into the military conscription of France, and the object with which I undertook these enquiries, in order to enable you to judge how far the information I am about to lay before you is deserving of confidence.

Soon after my return from India, in 1863, I had occasion to investigate the nature and extent of the control exercised over military expenditure in France, with a view to ascertain how far the system of control which I had aided in carrying out in respect to the Military Finance of India, resembled the efficient French system. These enquiries necessarily brought under my notice many parts of the French military system, amongst others, the arrangements for supplying the French army with recruits, at first only in so far as regards the cost. Having however been appointed a Member of the Recruiting Commission formed by Her Majesty during the course of last year, to enquire into the recruiting of our own Army, I was thus led to contrast the recruiting system which obtains in France, with that of our own. From my previous enquiries into the military expenditure of France, I had acquired some knowledge of the best sources for obtaining information in regard to the details of the French conscription; the opportunity for using this information arose out of the Report and recommendations of the Recruiting Commission. I am not here this day as the advocate of that Commission, but it will be remembered that it was formed, and the instructions were framed for its guidance, prior to the great events in Germany. The nature and

extent of the Report were necessarily limited by the instructions, and the recommendations, no doubt, appeared meagre and restricted, when the public mind was excited by the rapid successes of Prussia, and the preparations then making on the Continent, especially in France and Germany, to raise the military forces to a very high scale. No doubt this can only be most successfully done by the great command which continental nations have over supplies of men, from the power of conscripting every man fit for service into the Military and Naval services; but I may add that there are recommendations in the Report on Recruiting, which, if fully carried out, would remove some of the difficulties experienced with our system of voluntary service in obtaining recruits, and in rapidly increasing the military strength.

The state of public opinion gave rise to discussions both in public and private, as to our available resources for defence in case of necessity. The Statistical Society (on whose Council I have the honour to serve), ever alive to the importance of examining those measures that concern the welfare of the country, considered that the information I appeared to possess on the military conscription of France, might advantageously be communicated to the Society. Accordingly, in compliance with the views of the Council, I read before that Society, in the early part of this year, a portion of a long paper now in course of publication in the *Statistical Journal;* and the Council of the Royal United Service Institution having been pleased to invite me to contribute my mite towards the vast store of military and naval information already collected in its Proceedings, I shall now endeavour to give, in outline, the substance of the Statistical paper above mentioned.

Prior to the Revolution, the army of France was composed of Frenchmen voluntarily enlisted, of foreigners induced to take military service in France, and of a Militia formed of the contingents that the villages were bound to supply. The large increase made by the Revolutionary Government to the military forces, rendered necessary the adoption of more efficient means than voluntary enlistment, for the maintenance of the Army.

In 1789, the conscription was first proposed to the National Assembly, but was rejected as a criminal attempt on the liberty of the citizens; and it was decided to continue to rely on voluntary enlistment. In 1791 however, the volunteers who were at liberty to return to their homes at the close of each campaign, quitted the armies on the frontiers in spite of the prayers and even the menaces of the National Assembly. In 1792, the Minister of War pointed out the difficulty of recruiting the Army, and on the 22nd July, of that year, the country was declared in danger. New battalions were then organised, and the patriots of other nations were appealed to, to furnish fresh foreign legions. These measures would however still have been insufficient, had not the Convention on the 24th February, 1793, authorized an annual requisition of 300,000 National Guards, selected from the fit men of from 18 to 40 years of age—unmarried, or widowers without children—an immediate call of the same number being made in that year. Still more stringent measures were however deemed indispensable in

order to protect France from external attacks. Accordingly, on the 23rd August, 1793, on the proposal of Carnot, the National Convention decreed the levy *en masse*, and decided that until the enemy should be driven out of the country, every Frenchman should be permanently liable to military service. This measure produced the anticipated results, the population of France—then 25,000,000—supplied an army of 425,000 men, which freed the country from invaders.

On the 5th September, 1798, (19 Fructidor, an VI) on the Report of General Jourdan, the Directory and Councils of the Republic passed the conscription law, which for the first time made military service obligatory, and under which every Frenchman was liable to become a soldier, and serve for the defence of his country. Exemption was granted only to men married before the law was passed, and to those who had paid their debt of service in previous wars.

The conscription included every Frenchman between 20 and 25 years of age completed, and the youths drawn were divided into five classes, according to the year in which drawn. The number of conscripts called into active service was also ordered to be annually fixed by a special law. The above limitation of age applied in all ordinary cases; but under extraordinary circumstances, when the country was declared in danger, the levy *en masse* might be authorized, as in 1793.

This extreme measure could however only be of short duration, and was accordingly modified by the law of the 8th March, 1800 (17 Ventose, an VIII) under which the power of *remplacement*, allowing the conscript to be replaced by a substitute, was re-established, under certain restrictions. Thus, it was only allowed in the case of those admitted to be unequal to the fatigues of war, and those who might be considered more useful to the State, by continuing their professions and studies; and as these points were subject only to the judgment of the sous-prefets, who decided on the advice of the maires, there was necessarily great partiality in favour of, or against individuals. Conscripts thus replaced, continued however on the conscription lists, with a view to the contingency of the substitute deserting; and only obtained a final discharge, when the substitute died under the colours, or was discharged on account of wounds or ill health, or at the close of the legal period of service.

The conscription was maintained as the means of carrying on the struggle into which France had then entered against Europe, and supplied the resources in men, by which the first Empire was enabled to carry on the campaigns during the first 14 years of this century. The burden thus laid on the French population was, however, very heavy, and at times excited great discontent. Its abolition by the Charter of 1814 was therefore generally welcomed. It is calculated that during the existence of the conscription law, from 1798 up to 1814, about 2,500,000 men were called under the colours, but only 2,100,000 were actually incorporated, so that about 400,000 must have been refractories or deserters.

In the law of 1818, initiated by Marshal Saint-Cyr, under the restoration, the word conscription was not even mentioned. Voluntary enlistment appeared to be the principal element of recruiting, and the

"appel," or levy, as the subsidiary means. The effective peace strength of the army was then fixed at 240,000 men, and was proposed to be kept up by annual supplies, not exceeding 40,000 men. The contingent was apportioned between departments, arrondissements. and cantons, according to the number of their population; and was formed by being drawn by lots amongst the youths of 20 years of age. The rights to exemptions and dispensations were wisely defined, and claims decided on by a Council of Revision, whose character was a sufficient guarantee, both to the State and to individuals, for the fairness of their award. Voluntary enlistment into the Army was allowed, but was gratuitous, the payment of bounty being prohibited; and a re-engagement for a second period of service, though permitted, only gave a right to higher pay. Under the law of 1818, the full period of service was fixed at 12 years, of which 6 were in the active army, and 6 in the veterans; but it was modified by a law of 15th January, 1824, which abolished the corps of veterans, and reduced the total period of service to 8 years, either in the active army or in the reserve of young soldiers. The strength of the annual levy was then increased from 40,000 to 60,000 men.

Remplacement was authorised without administrative intervention, except in so far as regards establishing the fitness of the *remplaçant;* the person thus replaced, remained liable to be called into service during a year, in case of desertion. All those drawn by lot, or their *remplaçants*, were incorporated into the Army, but might be left in their homes, to be called into active service as required. Any further demands on the population were to be provided for by a special law.

After the Revolution of 1830, it was decided under the law of 11th October, 1830, that, instead of fixed contingents of 40,000 and 60,000 men, as determined by the laws of 1818 and 1824, the strength of the contingent should in future be fixed by special decree every session.

The main principles of the law of 1818 were, after a trial of 13 years, fully maintained, by Marshal Saint-Cyr's measure being embodied in the law of 21st March, 1832, which continues up to the present day to regulate the recruiting of the land, and marines or sea forces of France.

The utter insufficiency of voluntary enlistment for recruiting the French Army under ordinary circumstances, is considered in France to be fully established, by the fact stated when the law of 1832 was brought forward, viz., that during the 11 years between 1818 and 1828, the number of voluntary enlistments did not, on the average, exceed 6,395 annually. In the proposals recently made in France to alter the existing system, it is stated that during the last 20 years—not taking into account the engagements contracted by youths of from 18 to 20 years of age, which are in fact, for the most part, only anticipatory of their being drawn under the conscription—the number of voluntary enlistments has never exceeded from 3,000 to 4,000 in any one year. At critical times, the national spirit of patriotism has never failed to call forth a large number of volunteers in France; but these temporary responses to danger form no permanent resource for the maintenance of the Army.

The important point in connection with the conscription, to which I wish to draw your special attention, is the means of supplying the Army with the numbers annually required to maintain its established strength; and as this depends on the number of youths who annually complete the age of 20 years, at which they become liable to military service, I must briefly explain the state of the population during a series of years.

It will be found on examination, that only a very small augmentation has taken place during a period of 43 years, in the population of the French Empire.

In 1821 the population was found to be 30½ millions, and by the returns compiled in 1866, it was shown to be 38 millions, being an increase of only 7½ millions. The number of youths who in the year 1821 became available for military service, as having completed their 20th year on or before the 31st December, was found to be 288,828. These were the survivors out of the 464,562 males born in 1800, giving a percentage of 62·17 surviving to complete their 20th year. In like manner the number of youths who in 1864 were available for service, as having completed their 20th year on or before the 31st December, 1863, was 325,127; giving a percentage of 64·64 survivors out of the 502,927 males born in 1843.

The aggregate number of males born during the 43 years extending from 1800 to 1843, I find to be 21,587,548; and the number who, during the interval between 1821 and 1864, became liable for military service by reason of completing their 20th year, was 13,201,110, giving a percentage of 61·15 of survivors to births on the whole period.

The percentage of males who survive to enter their 21st year has, however, varied considerably in different years of this period. It was only 58·22 during the five years from 1820 to 1824, but was as high as 64·04 for the four years between 1860 and 1864; thus indicating a considerable improvement in the life rate of French males.

I have now before me a table of the number of males born in each of the 64 years from 1800 to 1864. The largest numbers were 522,116, born in 1859, and 513,204 in 1814. The lowest numbers were 460,910 in 1847, 463,443 in 1855, and 464,562 in 1800. This table therefore shows but little increase to the resources of men during the past 64 years.

The diminution of the number of male births during the latter years of this period, will necessarily diminish in future years the number of youths available for military service.

The largest number who in any one year of this century completed their 20th year was 326,298, in 1834, being the survivors of those born in 1814. The nearest approach to this number was in 1863, when the youths placed on the conscription list for 1864 numbered 325,127, being the survivors out of 502,927 males born in 1843. The annual report for 1865 on the recruiting operations of the French Army shows a falling off, only 321,561 youths having completed their 20th year on or before the 31st December, 1864; these being the survivors out of 492,703 males born in 1844.

The number of youths who may be expected to complete their

twentieth year on or before 31st December, 1867, does not exceed 299,000, being only about 10,000 above the number who survived in 1820 out of those born in the year 1800; shewing a very small increase in the recruiting resources of France since the beginning of the century.

The number of survivors in the present year may be considered to be estimated tolerably accurately as above, judging from precedents.

The number estimated to survive out of the 492,703 males born in 1844 was entered in the printed table now before me at 320,256; but since then the census tables have been published, shewing that 321,561 youths were placed on the conscription list in 1865 as actually available. This gives an excess of only 1,300 in the actual over the estimated number, and is a fair illustration of the extent of the improvement in the present life rate of France, as compared with that of former years; so far indicating a corresponding extent of improvement in the condition of the people of France.

I must now explain the mode of carrying out the conscription. Out of the French Revolution arose the excellent system of strict registration of births, deaths, and marriages. The birth of every male is registered in his own commune; and every year, all the youths surviving to complete their twentieth year on or before the 31st December, are placed on the conscription list of the following year. The whole number of that age are called the "class" of the year.

The Legislative Chambers of France annually fix the total number to be drawn by ballot as conscripts from the class of the year. This is called the contingent of the year, and the Emperor apportions it among the 89 departments, in the proportion which the contingent bears to the number of youths of 20 years of age available in each department, the census tables published every five years being taken as the data for fixing the proportion. The sub-division of this number amongst the cantons of the respective departments is made by the prefets on the same basis; and the several communes in each canton furnish youths according to their available numbers. So strictly are the registration and census tables kept, that very few youths ever escape being inscribed on the Lists. Omissions may occur in the first year or two, but as soon as discovered, the youths are included in the conscription lists of the following year. Those that escape this vigilance and attain their thirtieth year, then become free; but not more than five or six thus escape in a year. The number who, having been inscribed, fail to present themselves when called on to join the ballot for the conscription, is considerable; but they are returned as refractory or insubordinate, and are placed first on the list as soon as found. It is only after the lapse of many years that they cease to be liable to punishment for thus evading their responsibilities; and their civil rights being placed in abeyance until they have fulfilled the conditions of the law, it is the interest of every citizen of France to present himself for ballot in the commune to which he belongs, at the time that he becomes liable to military service, and is inscribed on the lists.

In order to maintain the most careful supervision over the recruiting

of the Army, Councils of Revision are every year formed in every department of France. These councils are composed of high officers of state, entrusted with the duty of supervising the selection of men for the military service. I find that, excluding subordinate officers, no less than 801 officers of rank and position are employed during 40 to 50 days in each year, on the recruiting service of France. The daily and hourly employment of these officers is closely scrutinised by the Minister of War; the time must be carefully accounted for, and any remissness is remarked on.

These officers may be thus enumerated:—

89 Prefets.
89 Councillors of Prefecture.
89 General Councillors.
89 Councillors of Arrondissement.
89 General Officers.
89 Sous-Prefets.
89 Sous-Intendants.
89 Military Medical Officers.
89 Commandants of Depôts.

The proportion which the military strength, including those in reserve, as well as under the colours, bears to the population of the country, is another important point in correctly estimating the recruiting resources of France.

In 1832, when the annual contingent of conscripts drawn from the fit males of 20 years of age was fixed at 80,000, there was nominally, on the aggregate of the contingents drawn from seven years' classes, a total of 560,000 men, either in reserve or incorporated with regiments; but after deducting the *non-valides*, or unfit men, the number was really reduced to about 500,000, being about $\frac{1}{64}$th of the then population of 32 millions. If this proportion were maintained, with the population of 38 millions, as shew by the last census, the aggregate number of fit men obtainable from the classes of seven years would be 593,750; not very far from the number (600,000) considered, until lately, sufficient to protect the honour of France, and maintain the country in security. It does not appear, however, that the aggregate of seven years' contingents even of 100,000 can supply 600,000 fit for service. Since 1832 the number of *non-valides*, or unfit conscripts, has increased, so that a contingent of 100,000 men supplies only 72,000, or for seven classes about 504,000, including soldiers under the colours and in reserve.

As already stated, the strength of the annual contingent is every year fixed by a special decree of the legislative bodies. Its strength has varied considerably during the past 50 years, but, on the whole period, it has steadily increased. From 1818 up to 1823 the strength of the contingent was only 40,000. In that year it was raised to 60,000; and in 1830 to 80,000. In 1854 the contingent, which had up to that year continued to be fixed at 80,000, was, in consequence of the war in the Crimea, raised to 140,000. The same number was called

out in 1855 and 1856, and authorized for 1857, but the close of the Russian war allowed of the strength being lowered to 100,000. On account of the war in Italy, the contingents of 1858 and 1859 were again raised to 140,000 men; but peace was made in time to allow of the contingent for 1860 being reduced to 100,000 men. The same strength of contingent has been continued in subsequent years.

It is thus seen that the demands for men for the Army have in different years borne different ratios to the population. In 1821, with a contingent of 40,000, and a population of 30 millions, the ratio was about 1,300 of contingent for every million of population. With a contingent of 60,000 men, and a population of 32 millions, the ratio was 1,850 to each million. In 1841, with a contingent of 80,000, and a population of 34 millions, the ratio was 2,400 to each million. In 1854, with a contingent of 140,000, and a population of 35 millions, the ratio was 4,000 of contingent to every million. In 1860, with a population of 36 millions, and a contingent of 140,000, the ratio was 3,900 to each million. At present the ratio is 2,700 to each million, the population being 38 millions, and the contingent 100,000.

The variations in the proportion which the strength of the contingent in each year, for a series of 18 years, bears to the total number of youths inscribed on the census lists, are shown thus:—

1847....25·92	1853....27·00	1859....45·7601
1848....26·2135	1854....46·3688	1860....32·5807
1849....26·1607	1855....45·5726	1861....31·9822
1850....26·2647	1856....43·9614	1862....31·0611
1851....26·13	1857....32·1716	1863....30·9187
1852....25·6622	1858....33·8628	1864....30·7230

The number of youths who annually survive to complete their 20th year, cannot however be relied on as regards indicatjng the number eventually found fit for service, nor the number actually obtained out of the fixed contingent; because all do not come under examination, and some of those examined, are exempted from service.

From the tables I have compiled, I find that out of 7,378,610 youths inscribed on the conscription lists, during the 24 years from 1841 to 1864 (both inclusive), there were 4,710,413 examined as to fitness for military service. Of these no less than 2,416,731—that is, 51·31 per cent., or more than half—were exempted on various grounds. I find that 1,634,066, or 34·66 per cent. of those youths, were declared unfit for service on account of insufficient height and bodily weakness; whilst 782,665 were exempted on grounds recognised by the State, such as being the eldest of orphans, son or grandson of a widow or of a blind father, or as having a blind or impotent brother.

Taking one single year as an example, I find the number of youths of the class of 1863 stated in the official Report on Recruiting for 1864 at 325,127. Of these, 204,870 were examined, in order to obtain the contingent for 1864 of 100,000. The number exempted on various grounds was 104,827, as below. The whole percentage of exemptions was nearly the same as for the whole of the previous period of 24

years; but the percentage exempted on account of insufficient height and bodily weakness was somewhat lower.

Ground of Exemption.	Number Exempted.	Percentage of those examined.
Undersized	11,421	5·57
Infirmity	57,659	28·14
Eldest of orphans	2,061	1·00
Son or grandson of widows	13,381	6·53
Son or grandson of men of 70 years of age, or blind	739	0·36
Youngest of brothers, blind, or impotent	64	0·03
Eldest of two brothers drawn at the same time	85	0·04
Brothers of soldiers under the colours	16,771	8·18
Brothers of soldiers who have died on active service, or been invalided on account of wounds or ill-health	2,646	1·20
Total number exempted	104,827	51·16

Thus in 1864 there remained out of the number examined, 100,043 actually available—somewhat above the strength of the contingent required.

These figures do not, however, represent the actual effectives, because the number is subject to still further diminution, by reason of dispensations from joining the service being accorded. Those exempted on the ground of bodily weakness, and on the recognised claims above enumerated, are replaced by others inscribed on the lists, and their exemption does not therefore entail any diminution of the strength of the contingent; but youths entitled to dispensations are not replaced, and the contingent of the year is thereby diminished. Dispensations are granted to all who already hold commissions in the Army, those borne on the maritime inscription, students of the Polytechnic, members of public institutions, educational students, and those who gain the great prizes at the Universities or Institutes. They are not called on to serve, so long as they are under these categories, but, if within seven years from the time of being drawn they cease to belong thereto, they become liable to military service. During the above period of 24 years, 255,769 of the youths drawn as conscripts, were dispensed on these grounds; and the number of dispensations in 1864 was 10,739.

Other causes lead to still further diminution. During the 24 years (from 1841 to 1864), 67,607 conscripts have failed to respond to the call for service; 19,403 were not available, in consequence of the inability of cantons to supply the fixed contingent; and those in prison, in hospital, or left at home on special grounds, have increased the number of non-effective conscripts.

The exonerations pronounced of late years, under the special law passed in 1855, allowing conscripts to purchase their discharge, have largely diminished the number of conscripts available for filling up the ranks of the French Army. During the ten years, between 1855 and 1865, there were 215,592 conscripts exonerated, by means of purchase; and in the year 1864, out of the 100,000 conscripts, forming the contingent, 20,566 purchased their discharge.

It rarely happens that the whole of the fit men of the contingent are in the first year called on to join the active Army, those not called out being included in the Reserve, and remaining liable to service for seven years. During the past few years large numbers of the contingents have been left in their homes, but these were drafted into the Army on occasion of the war with Russia, in Italy, and recently when war with Prussia appeared imminent.

It appears, as far as I have been able to compile the returns, that out of the 2,302,234 youths forming the aggregate of the contingents fixed for the 24 years from 1841 to 1864, there were 1,543,384 brought under the colours, being an average of only 64,308 per annum, apparently no great burthen for a country like France to sustain.

The great merit claimed for the continental systems of conscription, consists in the two very opposite conditions, of facilitating, both the augmentation and reduction of army strength, with great promptitude. The extensive resources in men which the conscription places at the command of foreign Governments, enables them, whilst maintaining an army at uniform but minimum strength in time of peace, to augment the military forces in time of war to a very high scale. It has therefore been the subject of most careful study on the Continent, how to adapt the several branches of the Army, to suit this power of expansion.

The French military force is a good illustration of the best way of utilising such resources; and past experience fully proves that it has been so well organised, as to allow of its being rapidly raised to a war establishment, with but little of that confusion and financial derangement so generally arising from sudden augmentations of military strength.

To this end, a peace or minimum army establishment has long been carefully elaborated for France, and agreed to by the most distinguished soldiers and statesmen of that country. The cost has been so accurately calculated and accepted by the nation, as to prevent those frequent variations, so detrimental to real efficiency and true economy. The Army establishment is seldom allowed to fall below this minimum strength; and on those rare occasions, the diminution is in general only in the grade of private soldier. The grades of officer and non-commissioned officer, are generally maintained at a fixed strength, being but little affected by reductions or augmentations. They form the permanent cadres, which are so composed as to be equally well adapted for the efficient discipline of the maximum force of privates that can be assembled under the colours, as for keeping up in the minimum Peace Army, that high state of discipline and training

which can without injury allow of extensive incorporations of young and untrained soldiers.

The maintenance within the territory of France of the greatest possible number of cadres of regiments—with a view to a rapid augmentation of the military strength, on a well-organised and efficient basis—is an important principle of the French military system. As few as possible, of the cadres of regiments are ever detached out of France; the requisite strength for foreign service being provided simply by raising the number of privates to the war strength fixed for the cadre, and the untrained men required for the augmentation are, without deranging the corps, easily incorporated with the trained ones. Thus, the conscription, combined with this organization, supplies the Government with the means of carrying on the military duties, with that economy which is the certain result of arrangements based on order and regularity.

The other advantage claimed for the conscription is, that an army may rapidly be reduced to a great extent, without the nation being deprived of the advantage of having soldiers available in case their services should be suddenly required; but these two very different results of the conscription will be best shown by a brief account of the principal variations in strength of the French Army, within the space of a few years.

Taking the period extending from 1st January, 1845, up to 1st January, 1866, I find that the strength of the French Army in non-commissioned officers, corporals, and privates, including also the Administrative Services, Medical, Ordnance, and Commissariat, was on the lowest scale in 1845, being then only 307,844. In 1854, the year of the war with Russia, the strength of these three grades was but little higher, only 310,267; and the number of privates was only 254,766, actually below that of 1845, which was 258,219.

In 1848, the year of the change of Government, the Army was nearly at its lowest strength, and the following year it was raised 100,000; the increase being mainly in privates, the number of non-commissioned officers being but little added to. The returns of each year, following 1849, show a diminution of strength, until, on 1st January, 1854, it was lower, in privates, than in any previous year of the period, and altogether lower in numbers than in any other year, except in 1845. The war with Russia in 1854 necessitated a large augmentation, and on 1st January, 1855, the total strength under the colours was 507,432 non-commissioned officers and soldiers, showing an increase of about 200,000 above the strength of the previous year. On the 1st January, 1856, the strength in non-commissioned officers and men was 526,056; and as this was above the maximum strength for which the regimental cadres had been adapted, these were then also increased. At the close of the war with Russia the Army was decreased, until, on the 1st January, 1858, the strength was brought down to 326,874, this being the third lowest scale within the period. In 1859, the Army was again largely increased, in order to meet the necessities of the war in Italy; and on 1st January, 1860, it stood at 559,902 non-commissioned officers and men; which was the highest

strength reached during the period. Since then the strength has greatly fallen, being reduced in one year by 130,000 men; and on 1st January, 1866, it stood at 370,667, being but little above the strength existing 21 years before. I have no doubt that it will be found to have fallen, by the 1st January of the present year, considerably below this strength, probably nearly as low as in any previous year; seeing that there were more than 52,000 men entitled to their discharge on or before the 31st December, 1866, and the incorporations and re-engagements were not, as far as I can judge, sufficient to maintain the strength as it stood on 1st January, 1866.

I have also no doubt, that the French Army will be found to have been largely augmented by the 1st May of the present year. If the larger portion of the available Reserve was really incorporated with the active Army, as ordered, its strength will have been raised to more than 550,000 men; and, with the conscripts of this year, it might reach nearly 650,000 non-commissioned officers and men. I may add, that the numbers of the cadres have varied but little during and since the war with Russia; the augmentations and diminutions made during the last 12 years being mainly in privates.

The elasticity of the conscription system is proved by the fact, that thrice during the above period, the Army of France has been at its minimum strength, almost immediately prior to great events that necessitated a great augmentation, which has been easily effected by the conscripts in Reserve being called on to join the Army.

The ease with which these great and rapid changes are effected, results entirely from the strong Reserves in men, which the Conscription Laws provide for the armies of continental nations; but there are differences as regards the extent of these resources in different countries.

In Prussia, every man fit to bear arms is for a fixed number of years made available for military service, and exemptions are very rare. In France, however, only a portion of the youths, fit for service, are liable to be withdrawn from civil life for the Army, and there are many grounds of exemption. As already shown, the proportion drawn for the contingent has, during 18 years, varied from one-fourth to one-third of those who complete their twentieth year. And even out of these, only a portion are ordered to join the active Army in the year in which they became conscripts. Thus, I find, that out of the six contingents of the six classes, from 1859 to 1864, inclusive, comprising 600,000 men, only about 175,000 conscripts were incorporated into the active Army of the land and sea forces; leaving, even after deducting the unfit, and those dispensed and exonerated, more than that number of men fit for service in the Reserve. These are at all times available in case of emergency, and, as above stated, all the conscripts, some of them having only one or two years to serve, were recently ordered to join the French Army.

The Reserve is also partially composed of old soldiers, who, having served in the Army, have been transferred to the Reserve, before having completed their seven years' service under the colours, and are

borne on the rolls until the expiration of the legal period of service required by the conscription.

The number of old soldiers in the Reserve has varied very considerably, during the period of 18 years; the largest number being in 1861. In that year, out of 152,197 men borne on the rolls of the Reserve, 107,471 had served in the Army; this large number being attributable to the extensive reductions made in the active Army subsequent to the war in Italy. It has several times happened, however, that the number of old soldiers on the Reserve has fallen below 100, in consequence of the French Government allowing soldiers to go home on furlough, instead of incorporating them with the Reserve. There were 87,609 old soldiers discharged in this manner, in 1857, in 1858, 161,261, and 64,471 after the Italian war, in 1860.

This point of the maintenance of a Reserve is very important, in connection with the solution of the question as to how long a nation can supply men to carry on war, and what is the largest efficient force that can be kept up. As regards France, it is pretty well ascertained, that at the close of the Crimean war, her Reserve resources in men were entirely exhausted, and the Army was dependent on the annual contingent. I cannot here enter into this wide question, but I can give a few details in regard to the French Reserve fluctuations.

The Reserve, which on the 1st January, 1848, stood at 86,312, had, on the 1st January following, fallen to 14,931; the conscripts not previously incorporated with regiments, having, on the Revolution of 1848, been withdrawn from the Reserve, and brought on the rolls of the active Army. Between 1849 and 1854, the limited strength of the Army enabled the Government to increase the Reserve; which on 1st January, 1854, was 157,802 strong, and it was with this Reserve that the French army was so largely increased. The war with Russia exhausted the Reserve, for it was only 11,755 strong on 1st January, 1856. The peace which followed, and the discharges from the Army, brought the Reserve up to 149,294 men on the 1st January, 1859. The war with Italy again reduced the Reserve, and it was only half that strength on 1st January, 1861. And then, six years of peace having brought the Reserve to a higher strength than ever before, it must recently have been entirely exhausted, by incorporation in the active Army. During the period of 22 years, the Reserve was mainly composed of conscripts, many of whom never joined the Army. Its strength was highest on the 1st January, 1866, being then 220,024, of whom only 9,063 were old soldiers. On the 1st January of the present year, the Reserve was probably about 250,000 strong; and it was from this body that the Emperor drew the means of augmenting the Army of France to the high establishment of which the newspapers made mention, in reference to the threatened war with Prussia.

It is therefore evident, that when the Reserve is drafted into the Army, the maintenance of a large military force in France must be dependent on the annual contingent of conscripts. The population of France has never been called on, in any one year, to supply more than 140,000 men, and as out of these only about 100,000 have

ever been available for incorporation with the Army, it papears doubtful whether an army of 600,000 men could be supported by the present population, in time of war, supposing that the usual calculation of one-sixth of the Force being annually expended in the field operations, is correct.

As regards the military efficiency of the Reserve, I am unable from all I have read, to offer any very favourable opinion. In each of the 89 departments of France there is a recruiting depôt, usually composed of only two officers. In this depôt are kept the returns of the men in the Reserve, and the traces of individual soldiers sent to their homes are preserved. In each of the 89 departments there is an officer of rank in command of the troops, and the Reserve is under his orders, and may be called out for drill. This however involves expense, and until within the past few years, this calling out was rare, and, therefore almost useless, and the Reserve was considered to be ill-trained, indeed, almost uninstructed. Since 1860, an attempt has been made to organize and discipline the Reserve, by assembling it for exercise in the chief place of each department. During the first year of service, the recruits are under instruction for three months; in the second year for two months; and in the third year for one month. This new system of training is, however, described as having the inconvenience of multiplying expenses. It also throws on the Major of the regiment, already fully occupied, an increase of work and responsibility.

The last report of the Minister of War mentions the fact of the Reserve having been assembled for instruction; but, as no comment is made as to the success of the measure, I am inclined to look on it as a failure. Indeed, I think any efficient system of training for the Reserve would entail a considerable outlay; and thus neutralise the greatest merit claimed for the conscription, in the economy with which the Government can fill the ranks of the army with men partially trained as soldiers.

In the year 1855 a great change was made by the Emperor in the mode of carrying out the French conscription. The right of one of the nearest relations, within six degrees of kindred, to take the place of a conscript, when desired, has always existed. The right of a conscript to find a substitute has also existed from the commencement of the conscription; but during the necessities of the Revolutionary Government, the right to this kind of substitution was withdrawn, and its restoration under the law passed in 1800, was one of the boons which softened the severity of the calls for conscripts, which then commenced, and continued during the whole of the first Empire, to weigh so heavily on the people of France. During the first 14 years of this century, it was sometimes very difficult to find fit substitutes to replace those conscripts whose families were willing and able to pay; and the increased demand for such men raised the price paid for them to a considerable amount. Nor was this the only evil, for the responsibility for the continued service of the substitute remained on the conscript whose place he supplied; and it actually happened in some cases, that

in consequence of the desertion of substitutes, a conscript was ultimately obliged to enter the service himself, from inability to provide funds to obtain another substitute. Moreover, the classes of men found willing to serve in the Army for money, were very objectionable, of such bad character as to be disliked by officers and men, and often forced to desert. As a body these men were generally denounced, and nicknamed the "sold." In order to meet the great demand for substitutes, Societies were formed throughout France, to which private persons subscribed. These Societies professed to furnish men as substitutes, but were always denounced by the authorities as supplying objectionable characters, and often deceiving private persons.

Many attempts were made to free the Army from the stigma of receiving such a class of men, but it was not until 1855 that the Emperor succeeded in partially removing the evil, and lightening the burthen of the conscription. On the 26th April, 1855, a law was passed authorising the formation of an Army Dotation Fund, under a Commission, into which a certain sum was paid by conscripts desirous of obtaining exemption, the substitutes being then provided by the Minister of War. Soldiers in the ranks were also allowed to purchase their discharge, as well as to extend their service beyond the legal period of seven years.

Any youth drawing a number which makes him a conscript of the year is now at liberty, any time before joining the Army, to demand exemption on payment of the sum fixed by the Minister of War. In like manner, a soldier serving in the ranks may at any time obtain his discharge by paying down the sum fixed for the period of service he still has to render. The rate at which conscripts can obtain exoneration, and the rate to be paid by soldiers for each year of incompleted service, are annually fixed by the Minister of War, on the recommendation of the Commissioners of the fund; the amounts thus paid being placed in the Dotation Fund, which is well administered by the Commission of high Officers, who annually report thereon to the Emperor.

These rates of payment have varied almost every year since 1855. The first rate was fixed at 2,800 francs for the conscript. This was considered to be less than the sum then paid by families for substitutes, but it continued in force during the war with Russia. In 1857 it was reduced to 2,000 francs, and in 1858 to 1,800. The war in Italy caused it to be raised to 2,300 francs, and the Mexican War, in 1862, increased it to 2,500 francs. In 1863 it was again lowered to 2,300, at which rate it stood until the present year, when it was raised to 3,000 francs. This was the highest rate ever fixed, and indicated that war with Prussia was imminent. Since the Luxembourg Treaty the rate has been lowered to 2,500 francs. This is one of the most hopeful indications of the continuance of peace.

The amount to be paid for discharge, by soldiers in the ranks, has also varied from year to year, usually rising and falling with the rates to be paid by conscripts; but has always been greater in proportion than that required for a conscript before incorporation. In the

years 1856, 1860, 1863, 1864, and 1865, the rate was 500 francs for each year of unexpired service. In 1857 and '58, when soldiers were in excess of the numbers required with the Army, the rate was lowered to 350 francs, but raised in 1859 to 400, and in 1862 to 550 francs for each year. In the early part of the present year, when the differences with Prussia began, the rate was considerably raised, but it has lately been reduced.

The funds thus paid into the Dotation Fund are applied by the Minister of War to providing men to replace the conscripts and soldiers thus released from military service. The law of 1855 enjoins that the number of conscripts exonerated and soldiers discharged by purchase, should always be somewhat below the numbers found to replace them, in order that the Army may at all times be kept complete.

A full and detailed account of all these operations is rendered year by year to the Emperor by the Commissioners, and a copy of the report is laid before the Legislative Chambers. In the report on the Fund up to the end of 1865, I see that whilst 236,840 conscripts and soldiers purchased discharge, 245,763 men were induced by bounties to continue in the Army after the completion of their 7 years' service. The actual numbers kept in the service are in reality greater, because whilst soldiers are allowed to re-engage for varying periods of 3, 4, 5, 6, or 7 years, the numbers entered in the returns are calculated on the supposition that all take service for 7 years; thus, if 7 soldiers re-engaged each for 3 years' service, they would only count as 3 men of 7 years' service.

The bounties paid out of the Dotation Fund in order to induce men to join or continue in the Army, are fixed by the Minister of War, on the recommendation of the Commissioners of the Fund. The rates of bounty are always below the sums paid to obtain either exoneration from the service, or discharge from the Army. In 1856 the bounty was 2,300 francs for a soldier re-engaging for 7 years' service; in 1857 and 1858 it was 1,500 francs; in 1859 it was 2,000; in 1861, 1862, and 1863, it was 2,200, and 2,300 in 1864 and 1865. Recently, on war threatening with Prussia, the bounty was considerably increased, but has since been diminished. The same rates were paid to men entering the Army who had not previously served. The bounties for entering or continuing in the Army are not entirely paid down on engaging; usually only one-half is paid at once, and the remainder on completing the contracted period of service. When soldiers engage for less than 7 years' service, a part of the bounty is paid annually, but in general only one-half of the yearly rate, the remainder being reserved till the completion of the period of service. All unpaid balances due as bounties are paid to the heirs of soldiers dying before completing their service.

The one great object of the law of 1855 was to encourage trained and fit soldiers to continue in the Army beyond the 7 years imposed by the conscription law. Every encouragement was given to old soldiers to re-engage after 7 years' service, bounty as well as higher pay being then given, and on re-engaging after 14 years, a further increase of pay; and though not allowed a bounty after 14 years' service, yet

they served on for pension, which was augmented out of the Army Dotation Fund.

In 1859, the re-engagements by soldiers in the ranks were not sufficiently numerous to replace the conscripts and soldiers who purchased their discharge; and the Government then availed themselves of the power given under the law of 1855 to enlist men, who had not served in the Army. This was carried out entirely by the Government authorities, who thus practically took the place of the old Companies formed for the purpose of enabling families to obtain substitutes.

The right of families to provide their own substitutes has been continued, but restricted to the selection of those youths within four degrees of kindred of the conscript. Practically, the providing substitutes by families has entirely ceased. In 1865 the whole number thus provided was only 448, whereas in 1854, the year of the war with Russia, and before the new law was passed, there were 21,614 substitutes supplied privately by the families of conscripts.

The reports to the Emperor on the Dotation Fund, show minutely the great extent to which both conscripts and soldiers have availed themselves of the permission to purchase exoneration. In the very first year of the Fund, 1856, when war was being carried on, 22,427 conscripts purchased their discharge. In 1859 (the year of the war in Italy), the number was 38,325, and in 1860, when war was still going on, it was 23,275. In 1862 the number fell to 18,381, and in 1865, to 18,777. It will be interesting to see the effect that the expected war with Prussia this year has had on the purchase of exonerations from liability to military service. The number of soldiers who have purchased their discharge has also been considerable. In 1855, they were 3,268; in 1856 as many as 5,524; but only about 6,000 in 1858 and 1859, the number gradually diminishing with the continuance of peace.

Another point has lately been brought to light by the purchase of exonerations. As already stated, the conscripts belonging to the contingent of each year are annually divided into two portions, one to join the Army, and the other to remain in the Reserve; and the falling off in the number of conscripts purchasing exonerations, is traced to the conscripts of the latter portion not thinking it worth while to purchase their discharge. This shows that great confidence was entertained as to the continuance of peace, and the small chance of the Reserve being called into active service.

The small number of discharged soldiers who returned to military life, although the law of 1855 permitted them to return within 3 years of their discharge, is very remarkable. The numbers who by completion of service are annually discharged from the French army, vary from 50,000 to 65,000, and out of the large number of this class living in France in 1855 and 1856, only 5,165 availed themselves of the large bounty to re-enter the army, though war was then actually going on. The largest number of discharged soldiers that subsequently re-engaged in any one year, was 4,102 in 1861. In 1865 there were only 2,454. Thus it is seen, that in general when once a French

soldier leaves the Army he quits it for ever, and this fact is well deserving of notice in connection with the limited Reserve available in France in case of war.

The number of soldiers who re-engage before their service expires, is however greater. In 1855, no less than 23,092 re-engaged. In 1860 the number was 27,052, and next year 24,792, but it fell to 9,279 in 1865. Soldiers were no doubt at first induced to re-engage in such large numbers, by the immediate receipt, as permitted by the law of 1855—even before the expiration of their first period of service—of the bounty for the extension of service. This was subsequently altered, and accounts for the great falling off in number.

The number of substitutes engaged by the authorities to make good the deficiencies in re-engagements, has not been great, being limited to those required to fill up the vacancies caused by the purchase of exonerations, and not supplied by old soldiers. The largest number was 10,306, in 1861. In 1865 there were only 6,968.

The granting of exonerations by purchase, and the re-engagement of soldiers and engagement of substitutes by the authorities, have much diminished the severity of the conscription law, by largely reducing the number of conscripts forced into the Army. I find that the number of conscripts incorporated in the land Army during six years, including 1866, was only 136,103, being an annual average of 22,684; and this result is remarkable, seeing that the contingent has been 100,000 during each of the six years, and that out of the Army of about 436,000 men, one-seventh, say 60,000 is annually entitled to discharge.

There are great differences of opinion in France as to allowing conscripts to purchase exoneration from military service, and especially as to allowing old soldiers to re-engage after their seven years' service. On the whole, public opinion, judging by printed works, appears to be opposed to both practices, but it is certainly doubtful whether, if these two conditions did not exist, the French Army could be maintained at its present high standard, with a reserve to fall back upon, without increasing either the strength of the Contingent, or the duration of military service; and both these measures would fall so heavily on the people of France as to be borne with impatience by the people.

The operation of the law of 1855 has effected a considerable change in the composition of the French Army. The number of soldiers, who on the 1st of January 1846 were serving as volunteers, was 40,900, or 12 per cent. of the total strength; whilst twenty years later, on the 1st January, 1866, there were 72,546, or 18 per cent. of the strength. At the former date, the number of soldiers who were serving as "re-engaged" was only 12,500, or 4 per cent.; whereas, on 1st January, 1866, there were 100,307, or 27 per cent. of the strength. In 1846, the substitutes who had taken the place of relations drawn as conscripts, were 5,487 in number, or 2 per cent. of the total strength; whilst on the 1st January, 1866, they had fallen to 257. The substitutes serving as purchased men, numbered 82,759 on the 1st January, 1846; being 24 per cent. on the total strength; and on the

1st January, 1866, they had diminished to 47,472, or about 12 per cent. on the strength. Those who were serving on daily pay and not as regular soldiers, were only 439 in number in 1846, whilst in 1866, they had increased to 13,325, or 4 per cent. of the strength.

The greatest change is however in the number of conscripts serving in the Army on their own account. In 1846, the conscripts drafted into, and actually serving in the Army, numbered 194,595, or 58 per cent. of the strength; whereas, in 1866 there were only 132,538, or 37 per cent., the percentage having decreased year by year, since the law of 1855 was passed.

The change in the average length of service of soldiers is also very great. On 1st January, 1847, there were 53,209 private soldiers, or 16 per cent. of the total strength, of less than one year's service; whilst on the 1st January, 1866, the number was only 32,187, or about 8 per cent. On the 1st January, 1847, there were 91 per cent. under 7 years' service, and in 1866 only 67 per cent.; and in the latter year there were 33 per cent. above 7 years' service, against 9 per cent. in 1847. The private soldiers of more than 15 years' service, only numbered 4,329 in 1847, whereas, in 1866, they were 23,189 in number.

These various changes, both in the conditions under which men are serving, and the length of service of soldiers of the Army, have given rise to much discussion in France. General opinion appears to be in favour of maintaining the efficiency of the Army by having the main body of soldiers in all the elastic vigour of youth, between 20 and 25 years of age; but the advocates of this course would bring into the Army all the fit youths of the country.

This extension of liability to military service, would entail on the people of France the universal conscription in use in Prussia, instead of the more limited one hitherto in force in France. As regards one effect of that universal conscription, it was lately reported in the *Times*, that out of a thousand Germans entering into expeditions beyond seas, there are hardly more than two or three Prussians; their liability to serve in the Army preventing their leaving their own country, until they are too old to be enterprising.

The probable effect of a universal conscription in France from another point of view, may be imagined, when we consider that already, under the limited conscription, with a population of 38,000,000, the births are fewer in France, than in the United Kingdom with a population of only 30,000,000.

In order fully to contrast the effect of the two systems of recruiting the Military Forces, in France and the United Kingdom, it should be stated, that with an emigration drain on our adult population, of more than double the strength of the French Contingent annually drawn under the conscription laws, the population of the United Kingdom has nevertheless, for many years past, increased in a greater ratio than that of France.

Thus our resources in men, when called for the defence of the country, are relatively far more extensive than those of France, and

they increase year by year. This forms good ground for preferring the voluntary service system of our army, even though it may be more directly expensive, to the conscription in force amongst Continental nations, the former having the immense advantage of permitting the full development of the race, instead of inducing, like the latter, restrictions on marriages and births. Moreover, under the Training Act, which, though never put in force, still remains on the statutes, and is capable with a few improvements of being practically carried out, we have the means of enrolling upwards of 400,000 men in England and Wales alone, for defensive purposes, and of training them in their several parishes to as high a state of efficiency as could be desired.

Evening Meeting.

Monday Evening, June 10th, 1867.

VICE-ADMIRAL SIR HENRY J. CODRINGTON, K.C.B., in the Chair.

NAMES OF MEMBERS who joined the Institution between the 3rd and 10th of June, 1867.

ANNUAL.

Bateman, Richard S., Commander R.N.
Sloane, C. E. C. D., Captain Royal Sherwood Foresters Militia. 1*l.*
Waterhouse, Henry, Captain Lanark Artillery Volunteers.
Palk, Lawrence H., Lieut. Scots Fusilier Guards. 1*l.*

THE HYDRAULIC PROPELLER AS A MOTIVE POWER FOR SHIPS.

By Vice-Admiral G. ELLIOT.

The CHAIRMAN: I beg to introduce to you Admiral Elliot who has been kind enough to come here and instruct us this evening on the subject of a new motive power for ships. To many of us it will be new, and I am sure we shall all gain considerably by the information he is about to give us.

Admiral ELLIOT: It is not my intention to attempt any exposition of the various laws of hydraulics or scientific principles involved in the application of water to the purpose of propelling vessels. My opinion is that the laws of science which operate in the practical development of this invention are few and simple, and easily understood; and that it is owing to looking too far into the maze of science, that some clever men have fallen into such errors in prophesying the non-success which would attend this new application of water power. I regret to say that the invention has suffered much from the treatment it has received at the hands of some scientific men; but having now reached the region of success, we can afford to be generous and to forget the past: and all we ask is, that in the face of indisputable realizations of Mr. Ruthven's anticipations, and on account of the great importance of this invention for war purposes, and the enormous advantages it opens out to the science of naval architecture, our scientific opponents will in future come forward openly, and honestly support their views by argument, discussion, and proofs, as opposed to the facts we now have to lay before them.

Were I to refer to the correspondence I have carried on for years, and show you the annoyances and disappointments I have met with, it would prove how thankless and hopeless a task it is, to become a pioneer in the cause of improvement. But if men who well know the weight of their opinions, will still continue to disparage this invention, refusing to accept the evidence of facts, it may retard the development of this new propeller, but I am convinced that it cannot prohibit its final adoption for general use.

I wish this evening to court free discussion. I will lay before you a short description of the history of this invention up to the present time, with a statement of the facts which have been realized, and I will endeavour to point out the principal features, in which this new propeller will show its great superiority over the screw or paddle. I regret to say that I come before you not so well prepared as I could have wished, as circumstances have not permitted me to devote the time which I should have desired to the preparation of this paper. I do not come here to puff up an invention, nor to make personal attacks on any one, but to meet my brother Officers in friendly discussion on a point which I am sure will interest them all; and to add my support to the proceedings of this very valuable Institution.

The idea of propelling vessels by water is very old, and many attempts have at various periods been made to adapt the theory to practice, but all unsuccessfully, until Mr. Ruthven, of Edinburgh, an engineer, in the year 1839, invented an apparatus for doing so. Under the patent then obtained, two small vessels were constructed—one of nine feet long, with steam power, and afterwards in 1844, another of forty feet. These vessels were exhibited, the smaller one on the Union Canal at Edinburgh, and the larger one on the Forth. They attracted a great deal of attention at the time, and were very highly spoken of. They had been brought under the notice of the Admiralty by Officers of the Navy, and so favourably recommended that the Admiralty requested permission to inspect and experiment on the last-named vessel, and a report, which was highly favourable, was duly made on her performances by Mr. Murray, the present Chief Engineer of Portsmouth Dockyard. Great exertions were then made by the inventor to have the invention taken up, but he was entirely unsuccessful. Few appeared to know anything of the principles upon which the vessel was propelled; and the scientific and practical people were alike opposed to it. In 1849 a few improvements were made upon certain parts of the apparatus, for which a new patent was taken out. Fresh efforts to introduce it were again made, and another small vessel, thirty feet long, was built to illustrate the invention. This vessel was placed on the Thames. A smaller one, of twelve feet, was sent to the Great Exhibition in 1851. The one on the Thames attracted, as might have been expected, a great deal of notice, and was by many most favourably spoken of; and one Steamboat Company proposed taking up the invention, but ultimately abandoned their intention stating that if successful, it would throw out of use the many boats they had then on the river. The model in the Exhibition fared worse, though it pretended to be, and in reality was, one of the most valuable

inventions for commercial purposes in the whole exhibition; it was not so much as even *noticed* in the jurors' report. It was not until 1853, that the first vessel for commercial purposes was made and completed. This vessel called the "Albert," was built in Prussia, partly at the expense of the Prussian Government, by a Mr. Sydel, and the engines and other machinery were furnished by the patentee. It has been employed ever since, running regularly on the Oder, and has proved the complete success of the invention.

Since then, another vessel with this new system of propulsion, called the "Seraing," has been built at Antwerp, and I induced the Admiralty to send over Mr. Murray, Chief Engineer at Portsmouth, to examine and report upon her capabilities. I have a copy of the letter which was sent to the Admiralty by Mr. Murray after he had inspected the vessel, but it is too long to read it through. He reported favorably of what he saw, and recommended this mode of propulsion for adoption, especially for war vessels; although as far as the inconclusive evidence he obtained would enable him to judge of the speed obtained, as compared with the paddle in a sister vessel, it appeared that the hydraulic propeller as applied to the "Seraing," had a loss of speed of somewhat less than one-tenth. "The 'Seraing' was 130 feet long over all, 13 feet beam, and about 8 feet deep with a draught of water of about 3 feet. The engines are of 40-horse nominal power, with two cylinders of 24 inches diameter and 22 inches stroke, making 50 to 52 revolutions per minute, and working horizontally and direct upon the vertical shaft of a centrifugal pump."

I may mention with regard to this vessel that the drawings of her engines did not come from Mr. Ruthven, and that there is an alteration made in the discharge pipes which Mr. Ruthven objected to. But I am only carrying the history up to the present time. We shall presently see what facts we have arrived at, when Mr. Ruthven had his own way entirely.

Notwithstanding having two veritable vessels to refer to, both of which displayed considerable success, the same opposition was still made to the hydraulic propeller, so that nothing towards its development was done in this country until 1862, when in consequence of my urgent applications to the Admiralty, an order was given for an experiment to be made to test the hydraulic power, in a gunboat at Devonport. But it will hardly be believed that no one connected with the invention was consulted; and when it was discovered that the experiment was being made, and Mr. Ruthven went down to look at it, he found to his surprise that it was no child of his at all! the invention had been misapplied, and as he would not adopt it, this first Government experiment was unproductive. Well, that was the result of my first application to the Admiralty. But I never ceased my importunities until I obtained permission, in 1864, to have the hydraulic propeller fitted to the "Waterwitch."

I must say that I owe it entirely to the Controller of the Navy that this trial was made in the "Waterwitch." I am certain that if it had not been for him, the trial would not have been made. At that time the aspect of affairs was very cloudy indeed, in consequence of the oppo-

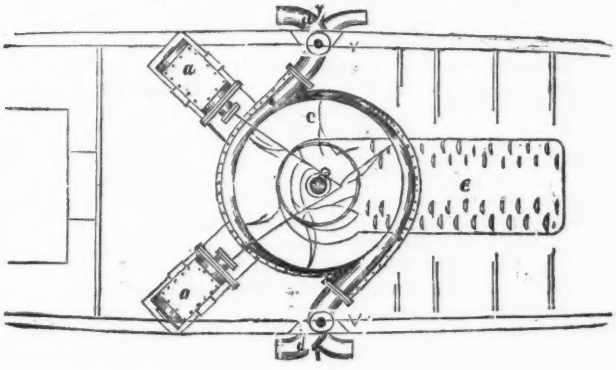
sition of scientific men, so that the responsibility was far greater to those who recommended the experiment to be tried in the "Waterwitch" then, than it would be to order its application on a larger scale now.

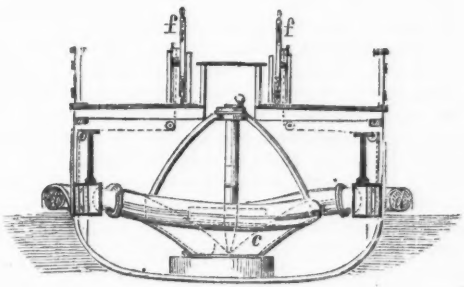
Here is an exact model of the "Waterwitch," not of her fittings, but of her form below the water-line. On seeing that it was a clumsy vessel, and thinking it might be desirable to get more speed, I proposed to take the same draught of water and the same displacement, and I sent up drawings of an iron vessel in which I proposed to put the hydraulic propeller. But it was said, as we are building two other vessels of this class, the "Vixen," and the "Viper," if we put the hydraulic in a vessel exactly like them in all respects, the trial will be so much the more convincing if it turns out that they have equal speed. I saw something in that argument, and of course I agreed to it at once. I was desired, with Mr. Ruthven and Mr. Murray, to prepare an engine for the "Waterwitch," which was done. I speak upon this point, particularly, because it has since been thrown out that the success which has attended this trial is not convincing, because the "Waterwitch" class of vessel is a very clumsy one to drive. I do not consider myself that this has anything to do with it. I think that to get 10 knots with 160-horse power out of such coarse lines, is perhaps more creditable than to get 11 or 12 knots out of a vessel with a finer water-line, a longer vessel, and an easier vessel to drive. That has nothing to do with the question. There is a certain power exerted, and there has been a certain amount of work done; and that is proof of the merits of the hydraulic propeller at the present time. All scientific men can easily make out whether it has succeeded or not. I think it is a very fair trial. If the vessels had been of finer lines, there would have been less work to do, and the same power would have obtained greater speed. I cannot understand why the trial, as it stands between the "Viper" and the "Waterwitch," is not just as fair as if they had been vessels built on faster lines. As a comparative test it is equally conclusive.

The drawings of the engines were prepared by Mr. Ruthven, assisted by Mr. Murray, and by Mr. Dudgeon, who has always lent us every assistance in his power. These are the engines in the "Waterwitch," (see diagram,) only they have three cylinders. I believe Mr. Ruthven rather prefers two; Mr. Dudgeon says he prefers three. It is a question which is best. No doubt, with two cylinders you get less friction, and with three you get more easy motion, but there is greater weight of engine, and I believe Mr. Ruthven still holds to his opinion that two cylinders, in certain circumstances, are better than three.

The results of all these trials are upon the paper in my hand. They are the Admiralty Reports:—on the "Vixen," the "Viper," and the "Waterwitch." It may be sufficient to take the two trials at load water-line of the "Vixen" and the "Waterwitch." They approach nearer in point of draught of water, in fact, they are within an inch and a half—the "Waterwitch" drew nearly two inches more water than the "Vixen" did. The "Vixen" was 10 ft. $5\frac{1}{2}$ in. forward, 11 ft. $5\frac{1}{2}$ in. aft. The "Waterwitch" 10 ft. 10 in. forward, 11 ft. 4 in. aft. The result was,

that the speed of the "Vixen" was 8·894, and that of the "Waterwitch," 9·255, more than one-third of a knot in favour of the "Waterwitch." The





mean draught of the "Vixen" was 10 ft. 11 in., the mean draught of the "Waterwitch" was 11 ft. 1 in. The co-efficients were, by the formula for speed and midship section, 317·7 in the "Vixen," and 327·7 in the "Waterwitch." And by the formula for speed and displacement, in the "Vixen" 107·4, in the "Waterwitch" 109·2, both in favour of the "Waterwitch" as by Admiralty showing.

Now, Gentlemen, I believe that every one knows that the essence of the whole affair is in those co-efficients. If the vessels were not exactly alike, the comparison would be no test of the value of the propeller; but where two vessels are exactly alike, midship section, displacement, draught of water, tonnage, the co-efficients certainly do show, if anything will show, the comparative value of the two kinds of propellers.

Having arrived thus far, I think we have a right to say, that we have facts, and we have a right to ask scientific men to accept those facts, or to give their reasons for not doing so. What I complain of is, that opinions are still expressed, and that unfortunately, those opinions have great weight towards a disparagement of this motive power. Those who disparage the system do not say, we have not done what we have done; they agree it is a success; but they now say, "when you come to try it on a larger vessel and with a greater speed, we do not believe you will succeed so well." I should be very glad if they would come and tell me why. I think if it be done in a vessel of the size of the "Waterwitch," they ought to be able to show why it will not be done in a vessel of larger size. I, on the contrary, say that as you increase the power, so you will improve the comparative speed as regards other vessels. And for this reason, that there is no slip here, and in the screw we know, as you get higher velocities, you do increase the slip. I am coming to that question of slip presently. You may say, "there is water friction," but I do not perceive it as far as present experience goes. I have got very good support from eminent scientific men with regard to friction, that water discharges itself through its centre, and that there is but little loss by friction.

Having given you a sketch of what has been done between the "Vixen" and "Waterwitch," I have no time to go further into it. I shall be very glad to answer any question afterwards.

I now wish to show that these are not the only facts we have got. We have a comparison between what the "Waterwitch" and what two vessels built by Mr. Dudgeon have done. They are vessels of the same type, the "Medusa," and the "Triton." I will show afterwards, as I go along, what Mr. Dudgeon himself says with regard to his vessels. Here are the whole of his calculations, and he here says, guided by his co-efficients and comparisons—(he was on board the "Waterwitch" on all her trials, and he has taken the Admiralty evidence of her diagrams)—"I therefore conclude that about 50 or "60-indicator-horse power was lost in the water propulsion. As com- "pared with the twin screw, it was about one-fifteenth of the power; "and as the twin screw vessel was fitted according to our own system, "the comparison is good." After that, I asked Mr. Dudgeon this ques- "tion: The 'Medusa' and 'Triton' had the same displacement, it is true; "but they drew three feet less water, and they were 30 feet longer. "Are they not an easier class of ships to drive?" Mr. Dudgeon, in his own words at the Society of Naval Architects, acknowledged that it was so; that although the displacement was the same, and the indicated horse-power was the same that was exerted, still drawing three feet less water and being 30 feet longer, they were an easier class of ship to drive, and he considered it quite made up for the loss in the comparative speed of the two vessels.

Therefore, we have substantial facts; but I am sorry to say, they are the only facts at present, unless I mention those connected with the "Nautilus," which vessel I am now about to refer to. This vessel was built at Blackwall by the patentee, Mr. Ruthven, at the expense of

private gentlemen, for the purpose of practically proving the advantage of the hydraulic mode of propulsion. The hull of this vessel is somewhat similar to that of one of the "Citizen" river steam paddle-boats, being about the same length, although much broader and higher between decks, and fuller in the lines. She is fitted with two steam-engines, each of about ten nominal horse power. The advantages of construction, so far as shape and size of hull are concerned, are on the side of the paddle vessel. Any superiority shown by this experimental vessel may therefore be confidently attributed to the propelling medium. The immense difficulty of inducing the public to attach value to what appeared so novel and extraordinary an invention, induced the owners to incur the expense of building this vessel purposely to prove the correctness of the inventor's calculations and the great value of the principle. Constructed on a model unusually full in the lines, and with no extraordinary power, this vessel may be considered to afford a severe and reliable test. The "Nautilus" having so completely fulfilled this purpose, the owners and patentee have invited the criticism of scientific mechanicians and the public, confident that an inspection of the vessel and ocular demonstration of her performance, cannot fail to prove the great superiority of this mode of propulsion for ships, over any other now in use. But, strange to say, this invitation has not been responded to with cordiality, or with any earnest intention of obtaining information by engineers and ship-builders.

A trial certainly did take place. A "Citizen" steamboat, the "Volunteer," was hired. The Admiralty sent their Officers to witness the trial, and their report of it was, that they went down the river together, they kept pretty even for a certain length of time, when the hydraulic gradually drew a-head and beat her—I forget by how many lengths. One of the Admiralty Officers attached to the Controller's department was on board the "Citizen" boat; and he can testify that they did everything in their power to drive her along, that it was as fair a race as could be. All we then wanted was to get the indicator diagrams of the two vessels. They were very nearly alike. The "Volunteer" had two 12-horse engines. She drew a little more water, had rather a more rising floor and less frictional surface, and therefore had better lines. Indicator diagrams of the "Nautilus," were taken, and we then asked to get the indicator diagrams of the other vessel. They were written for, offered to be paid for, and I am sorry to say without success; we never could obtain them, and we never have obtained them up to this day. Upon that I wrote a challenge in the *Standard* newspaper to any "Citizen" boat on the Thames to a trial with the "Nautilus;" the patentees offered to pay the expense of the trial. I am sorry to say that offer was not accepted. Under those circumstances, I have a right to claim that they were rather afraid of us.

However, I believe that the real cause is this, and it is a natural one to a certain extent:—If this hydraulic principle were to be established, it would set aside an enormous quantity of engineering plant throughout this country, and would probably disturb existing connections. And I have been told since, that if you go into a ship-building yard, and propose

to make any little difference in whatever is going on, it upsets the order of things; you alter the groove into which they have got, if you begin to introduce anything new. They say, that for these reasons it is evident that novelties create a loss of money; and we cannot therefore expect that engineers, who are making very good fortunes as it is, should be anxious to encourage a new motive power. We must, therefore, push it forward in the best way we can.

Well, then, in due time, as I have said, the "Waterwitch" appeared on the river, and her trials have proved, that to the extent of a vessel of 777 tons, and 160-horse power, the hydraulic has equal merits as a propeller to the screw or paddle. Now, then, comes the point! I am told that official and scientific advisers say that it does not follow that the same success will attend trials on a larger scale with higher rates of speed; in fact, that they express the opinion that it will not. I naturally asked for the grounds of support for this opinion, but that is not obtainable. Now, then, comes the point, the point at which we are stopping now. We ask for a progressive trial. We say to the Admiralty, "you have gone to this great expense of making a trial "when the whole thing was under a cloud, when everybody was in- "clined to speak against it: and, now, that you have got a certain "amount of success, and when you see the enormous advantages, "(which I am going to point out presently), which are likely to accrue "from it, surely you are not going to stop there. Let us have a larger "vessel. This is a 777 ton vessel; you are going to build vessels of "1,200 tons, let us have one to put the hydraulic in, that is all we can "possibly expect, we do not expect to jump at once to the largest class "vessel; although we feel confidence, we do not expect everybody to "have the same confidence." All I ask is to have a progressive trial in a larger vessel and at greater speed. I think a great mistake was made in not building the "Nautilus," to make her the fastest thing to go on the river; if we had got that, we should be in a different position from what we are in now.

On my part, I give reasons, which are I think admissible, for saying that the same results must be obtained in larger vessels. What has been done in the "Waterwitch" is simply this: a certain amount of work has been done for a certain power exerted, and this, when compared with the twin screw in a sister vessel, shows equally good results. Beyond this, in order to test the value of the propeller more completely, and the accuracy of the effective power of the propeller, a series of diagrams were taken at different rates of speed of the engine from 20 revolutions up to 40, and the speed of the vessel due to revolutions being known, it resulted, that the law, "that the power is as the cube of the speed," was fully exemplified. From 20 revolutions right up to 40,—I have got the paper here with the trials, showing the horse-power according to cubes of the speed, and addition for friction and variation, and the result is as I say—it came out, showing exactly, —that power is as the cube of the speed. We took those diagrams for our own information. I merely mention these facts to show that we are not trying to jump at conclusions, but that we have tried to satisfy ourselves by every possible means, and that our opinions are

worthy of reliance. Surely, it will not be advanced seriously, that if you double the horse-power, it can place this matter on a different footing. If it has been proved with a vessel of 160 horse-power, as it has been, it must act in the same way if you increase the power. It is of no use discussing such points as these, where opinions are allowed to be expressed, and to influence decisions of such grave importance, but where it is refused to submit the evidence to the test of public scientific analysis. I have heard something about friction whispered in my ear. It was yesterday conveyed to me that that was an objection that was raised; that as you get to a larger vessel the friction will be increased; and I have also heard of increase of slip to be overcome. The truth, I believe, is that there is little friction in the discharge of water through a pipe. Water discharges itself through its centre, and if the outer globules are retarded by adhesion to the surface of the pipe; it results in little loss of power to the engine; and even if it were so, to a slight extent, the larger the pipe becomes, the smaller the frictional surface as compared to the increase of the column of water discharged; and, therefore, if it has answered in vessels of the "Waterwitch" size, this supposed loss of power would be reduced as the engine power is increased. But I believe Mr. Ruthven will agree that the loss due to water friction is of very little consideration, if it exists at all. How does water flow through pipes for many miles, with the very slightest fall, with little alteration of speed? Added to that, in the discharge pipe of the "Waterwitch," at the very extremity of the outlet, there is a small flange put inside to retard, as it were, the outer globules, so that they may rest there as a cushion for the discharge of the inner water; and it is done expressly for that purpose. We have been often asked why it is there? People naturally come up and say, "Why don't you get that out of the way? "It is an obstruction." There it is, and we see no reason at present to alter our opinion. I wish I had thought of it, and invited a scientific gentleman who has had a great deal to do with the discharge of water through pipes, and who has written to me, corroborating exactly what I have said. He says, "talking of friction, it is all moonshine, and I "can prove it." And his proof is, that the water discharges itself through a pipe through its centre, and that the frictional loss is proportionately lessened by increasing its velocity or increasing the size of the pipe. Therefore, I think we have a right to dispose of friction altogether, as a reason why we are to do worse in larger vessels. As to slip, I maintain there is none at all.

Well, I will resume the subject of the "Waterwitch" and "Vixen" trials presently, and also show how, by comparison with two other vessels—the "Medusa" and "Triton"—the results have proved equally favourable to the hydraulic propeller, as regards the speed obtained. Having now a right to claim that so far, the hydraulic has, as regards speed, proved its equality to the screw, I wish to put before you in the strongest light I can, the enormous advantages this propeller will introduce in other respects, more especially in war vessels. I have lately read a paper at the Society of Naval Architects which brings to light in a most prominent manner the pro-

spective advantages of the hydraulic propeller. It is not my intention to read this paper through, but I shall read extracts from it:—

"In all past times one of the greatest merits of a naval architect "has been to produce an easy ship in a sea-way, this being a great "element of sea-worthiness in all vessels, and of efficiency in a war "vessel, as affording a steady platform for the guns. I think the "starting point of uneasy vessels was, when we put the first engines "into a ship of war. From that day, if my recollection carries "me back, we began to find vessels roll more than they did "before. It was a simple cause. The weight of the engine "placed upon the bottom of the ship was a great leverage. How-"ever, that weight might have been counteracted by weights "above, it was a great leverage to make a ship roll when a ship "was set in motion. The deeper the ship, the more it will roll. The "natural conclusion is that if these engines could be lifted that will "dispose of the difficulty. Then, when we added to that, armour "plate to the sides of ships, there was another leverage to make a "ship roll. And when we added to that, bow and stern batteries, "there was another great leverage to make a ship pitch. The over-"hanging weight of the screw with fine lines abaft, is also another "element of pitching. Consequently, we have arrived at such a "state of rolling and pitching that our ships are unserviceable; and I "feel it almost a duty to endeavour by any means in my power to "expose it and to stop it, believing, as I do, that it is quite unneces-"sary and easily avoided.

"If anybody takes the trouble to read the Reports of the Admirals "of the Channel Fleet, I cannot understand how he can sit down for "a day afterwards, and not endeavour to put a stop at once to this "lamentable state of affairs. The reports are by Admiral Yelverton and "Admiral Warden; and the way they talk about these ships and their "rolling is something frightful. Now, I knew of this before. I knew "it must be so, and I have always said it is sure to be so. I have "said, 'You are doing everything you can to make a ship roll;' and "I think, when we hear the reports of the 'Royal Alfred,' the way "she is knocking about, it is really time we began to think of amend-"ing our ways. The 'Achilles' I believe to be a steady ship. It is "something remarkable. I see here, when the 'Caledonia' was "rolling 14 degrees, and the 'Lord Clyde' 10½ degrees, the 'Achilles' "only rolled two degrees. Some of the rolling was 34 degrees and "36 degrees. I cannot explain the cause of this good behaviour on "the part of the 'Achilles,' as I am not aware in what respects she "differs from the other ironclads.

"The greatest defect of our ironclads, then, is their marked pro-"pensity for rolling, but the exceptional case of the 'Achilles' proves "that this defect admits of removal in future vessels. If it is not "removed we must attribute the fact, not to the difficulties of the "problem presented for solution, but to the negligence or incapacity "of the naval architect. It does not appear that arrangements tend-"ing to reduce rolling would in any way interfere with those intended "to secure a high velocity under steam, and in any case it is certain

"that the efficiency of a fleet depends so much on the steadiness of "the ships as to make it expedient to sacrifice other qualities in order "to secure one of such paramount importance." "Admiral Yelverton "reports that in his opinion a turret ship 'would have had a great "'triumph on this occasion.' The statement will, no doubt, be made "use of by the advocates of the turret system." That is the reason I make use of it here. "The whole tenor of the report confirms in "the strongest manner the adverse opinions which I have always "expressed as regards 'Monitors.' Meanwhile, the turret-ship to "which Admiral Yelverton alluded is as far removed from the "'Monitor' type as anything can well be. He writes, 'For there is "'no doubt that a sea-going turret-ship, say 12 feet or 14 feet out "'of the water, would have fought her guns without the slightest "'difficulty, and fired easily six shots to every one from our broadside "'ship. I do not here allude to the 'Wivern,' for the sea would have "'washed into the ports of her turrets, and swamped everything "'inside.'"

There is one point there. Admiral Yelverton says a vessel of 12 or 14 feet freeboard. Why on earth should the turret-ship not have 12 feet or 14 feet freeboard? Whenever I hear of a turret-ship, I am always told she must have a low freeboard. I never could understand why she should have a low freeboard, except in the imagination of those who wish the sea to come in. I do not see why we should not have a turret-ship with a high freeboard of 12 feet or 14 feet, or even a great deal higher.

Having introduced the subject of rolling, I then go to another feature which this paper, that I read, introduced. It was the immense importance that will be attached in future warfare, to running down vessels, to what we call "ramming." I do not know whether I am wrong, but I can fancy the sort of thing, and I know I should do it to-morrow if I was in the position. All my manœuvres, everything I could undertake to bring my ships into training, would have one object in view, which would be to have the greatest power of "ramming" and running down an enemy's ships. I have heard that one of our Naval Officers has lately written a clever paper upon that subject. I should have been very glad to have seen it, but I am sure I go heartily with it. Who on earth will stop popping away with his guns, when he can go "bang" at the enemy and sink him by one blow, if you hit him with the spur. But a screw vessel can only strike with one end, the bow, whilst one with the hydraulic propeller can strike with equal force with both ends, and therefore the ramming power is doubled—a most important feature. With reference to this point, I will tell you what was done the other day in the "Nautilus," before 24 witnesses, going ten knots an hour. We dropped a piece of wood over the bow, and the ship was stopped, dead, in half her own length, when the piece of wood was on her beam. And in ramming, if I see that I am likely to miss with one end of the ship, I can stop, and can go at full speed in the other direction, and I am sure to hit something in a *melée*. If, however, I have to turn a long ship like the "Achilles," my ramming power is very much restricted; therefore, I introduce

ramming as one of the greatest advantages connected with this hydraulic propeller. I have a rudder at both ends, but I do not care about the rudder, because I can steer without it perfectly well. But I have a rudder at both ends, and my principle in gun-boats is to fight with my stern towards the enemy, on the end-on principle. I will explain that presently. I will keep to the point I am talking of, viz., ramming, and I say that the hydraulic power alone, secures this perfect system of ramming. It also gives you a great increase of turning power, which is another element of ramming, for you can reverse the bow of your ship without turning at all, or move either end of your ship in the direction in which you wish to go, without making a circle.

I will now read what introduces the advantages of the hydraulic. At page 6 I mention, "At present I really believe that a gale of "wind would almost cause as much damage to the fleet as a naval "action." Now, I have heard a good deal about the fate of the "Royal Alfred" going out the other day. What I have said is, if one of these vessels should get caught in a heavy gale, and if from some accident to her engine she cannot use it, she will roll away her masts, and when she has rolled away her masts, I do not know what will become of her hull with the present momentum they have. The other day, with her engine intact, the "Royal Alfred" carried away her main yard; she started away her chain plates, and very nearly lost her mainmast. What would have become of her if her engines had stopped? We have never had an instance of that. I have had engines stop in the old "James Watt," in gales of wind, unfortunately, at the wrong time. If one of these ships got into heavy weather, and her engines were to be disabled, I think she would be very soon dismasted; I do not think canvas or anything would stand that great rolling. If she carried away her sails she would roll more, and would carry away her masts; and if she carried away her masts, she would perhaps lose her hull. We have never had a ship in that predicament; but we have the evidence of Naval Officers who have seen how ships roll, who tell us that it is time to go back to those old times when the great object of the naval architect was to make a good sea-boat, that is, an easy ship at sea. It is due to Officers and men, as they have to contend against heavy weather and hardships of every kind, that they should have confidence, that everything is done in the vessel they belong to, to make her as seaworthy as it is possible to make her.

I know the great difficulty of regulating weights so as to secure easy motion. In a deep ship the engines are low, and the leverage therefore great, and the armour belt is below the water line, but the whole weight of armour and guns has been placed on the sides of the vessel, with great weights placed in the extreme bow and stern, and thus all the elements of uneasy motion have been intensified, so that no amount of skilful designing could produce an easy ship.

I am very curious to know how the "Achilles" is so easy a ship as she is; there is no doubt of it, I believe.

I do, however, maintain that we have neglected to a great extent the importance of adopting all remedial measures to reduce, as far as possible, the causes of violent and extensive rolling and pitching. The

great object to be attained, to procure easy motion, is to concentrate as much as possible all weights, not only vertically towards the water line, but also from the sides to the central line, and also from the bow and stern towards the centre. The broadside principle is antagonistic to this. The bow and stern batteries are a part of this broadside principle, and are fatal to the sea-going qualities of a ship, therefore, the neglect of taking advantage of the turret principle has been a great mistake. To raise the weight of the engine considerably towards the water-line, and to get rid of the great weight at the stern, which the screw propeller necesitates, would remove all difficulty from the work of a naval architect. I am glad to say that this advantage is now within his reach by the adoption of the hydraulic propeller.

There is no reason whatever why the hydraulic propeller should not be placed near the water-line, if you like, engines and all; not one single reason. In fact, I believe it is the best place. If the water is coming in through the canal under the bottom of the ship, the more that canal rises to the engine the easier the access of the water to it. And you may raise the whole weight of the engine to the water-line, and in that way it is a mere matter of cargo, you can place it wherever you like. But I would prefer the nozzles to be sufficiently low down, not to roll out of water, and to be out of the way of exposure to shot. And yet we hesitate with such advantages within our grasp! There is far more to be gained than that by this new propeller; yet it appears, that like the turret-principle, it might have to stem the tide of prejudice for a lengthened period, except that I have great faith in the clear-sightedness and impartiality of the present Board of Admiralty. I have mentioned the hydraulic propeller as affording the means of facilitating, to almost any extent, the most advantageous distribution of weights, by raising the engines to any height required, and by dispensing with the great over-hanging stern-weights required by the screw-propeller. I would also call attention to another important advantage of the hydraulic, as contributing towards a steady platform. The turbine itself is a central weight, and from the great centrifugal force exerted, it will produce a certain amount of counteracting power to the rolling of a ship. You are discharging, I think, 350 tons of water in a minute in the "Waterwitch," from the turbine, and that is a great centrifugal force, acting as a steadiment to the ship.

It really is a most serious defect, that our present ships should roll about, as they do, especially when sails are furled; and what an unfortunate effect it would have upon the efficiency of a fleet when moving about in action, regardless of the direction of the swell. In heavy weather, I really do not believe that any spar or sails would stand the test of such heavy rolling; and if that means of steadiment were gone, there is nothing for it but to bow the sea with steam power. If that fails and the dismasted hull is left to its own momentum—such a case was bad enough in olden times—but what would it be now? and naval actions generally leave ships dismasted. Surely, then we should grasp at every means of so regulating the weights, that the easiest motion may be secured. The hydraulic, in this respect, will prove your best friend.

In many other ways ought this principle also to command the attention of naval architects. If the water be discharged above the water-line, the impediment to the speed of a ship, under sail, will be very slight, as compared with that caused by the screw, which, if not raised, is always a drag in the water, in addition to its retarding effect by increasing the sending and pitching of a ship in a sea-way. As the hydraulic has now proved itself equal to the screw at the *measured mile* by the speed obtained for the same power in similar vessels, it must be placed at great advantage, in a sea-way, when a ship is pitching, and the screw is making repeated visits into the air, because whatever the ship may be doing in the way of pitching, the hydraulic power is always the same; whereas, whilst the screw is out of the water, of course its power is entirely lost; and the steam that is being used to make those revolutions in the air, causes a dead loss of fuel. Therefore, in a long voyage, I look upon it that the hydraulic must prove, as against the screw, a very great source of economy. Let any one get on to one of our headlands, and see a screw-steamer trying to get round, with a foul wind; he will see the screw as much out of the water as it is in. Here is a great loss of fuel; a loss of speed; a great strain on the ship and engine; and, by prolonging the voyage, another cause of loss of money.

Another source of economy which the hydraulic provides, is when steaming and sailing. The speed of the screw must approach the speed obtained by the sails, before it acts as an auxiliary, and the steam which is expended in reaching that speed of engine, represents a dead loss of fuel. But the hydraulic propeller, when acting as an auxiliary to the sails, developes its whole steam power as an additional force; therefore, this must produce a great saving of fuel.

When the screw is superseded—as I feel convinced it will be—the naval architect will rejoice to find himself unembarrassed in designing a sailing ship, both as to the form of vessel, and as to the position of weights; and I believe that the nation at large may rejoice to see in the dawn of this new motive power, a revival of her maritime superiority, because it admits of a return to a more perfect construction of sailing vessels, and when good seamen will again become an essential feature of the strength of our sea-girt isles. Again, the hydraulic propeller causes no vibration, so that a great cause of discomfort is removed, and the weight and expense of strengthening a vessel to withstand the vibration of the screw, is avoided. Again, the hydraulic propeller will prove itself most valuable in reducing the danger of collision, as the officer in charge of the deck will have the power of stopping the ship in twice or thrice her own length from full speed, by reversing the nozzle-valves; and this power is under his immediate command on deck, without any orders to the engine-room. The handles to turn the nozzles are brought up to where the bridge is (see f.f. fig. 2); in fact, where there is sure to be somebody, who, at the word "Stop her!" would have nothing to do but to turn the nozzles round; and there is at once the whole power exerted to make the ship go astern. I have said, "in twice or thrice her own length," because, although the "Nautilus" stopped in half her own length, she is a very light

vessel. Many a man's life and much valuable property would be saved by this facility of not only stopping, but of returning to the spot where the man fell, without turning the vessel round. Having a rudder at both ends you can steer right up to the man; and I believe you would pick up a man quicker by the vessel than you would by lowering a boat. In fact, I have tried it with a piece of wood, and we could have picked it up in a shorter time with the ship than by lowering a boat. I consider that all new vessels with the hydraulic propeller will be shaped alike at both ends, and thus obtain equal speed both ways. This feature is invaluable to war ships by doubling the destructive power of ramming, which, I am convinced, will become the great element of sea-fighting. Having a ship, shaped alike at both ends, will be acknowledged, I believe, by everybody to be no detriment to speed, nor any objection as regards sailing or sea-going qualities.

To exemplify what I have said, I will give an instance of what has occurred quite lately. A vessel called the "Mary," whilst in the act of sounding, found herself in shoal water, on the edge of a bank. Owing to the orders, conveyed to the engine-room, having been mistaken, she was carried further on, and, before the mistake was rectified, she struck the bank heavily two or three times, abaft, and the first time she struck, the starboard screw and end of shaft broke off and disappeared at once. The vessel had no other damage done to her hull. The "Mary" was the property of the Messrs. Dudgeon. Now, with the hydraulic propeller, nothing of this kind would have occurred, as no orders are required to the engine-room, the directing power of the engines being under immediate control on deck; and in case of a ship striking the ground, whilst the screw is always subject to damage, the hydraulic is safe.

Again, the hydraulic engine, acting as an enormous pump, will discharge from the hold upwards of two tons a minute per nominal horse power; so that with an engine of 500-horse power nominal, 1,000 tons of water a minute would be discharged in case of shot-holes, or a leak, admitting the water, and there is no possibility of choking so large a discharge-pipe. If the holes were large enough for a man to come in with the water, he would be carried right through, and go out at the discharge-pipe; and I look upon it as a most important feature, that by merely closing the sluices, you can then discharge the water from the ship itself.

Again—(you will think I am never going to end with my advantages of the hydraulic propeller)—the hydraulic propeller can never be *fouled*, whilst the screw is easily disabled by floating obstructions in the water, as the nozzle can be protected by a shield, or placed under water out of harm's way; in action the motive power would be always safe, whilst the screw and sternpost must be, to a certain extent, exposed. I see that Admiral Yelverton remarks upon that; he says, he thinks he must be a very bad gunner who would not knock away the rudder of the "Bellerophon." when she is pitching, at the first shot. He mentions this in his Report to the Admiralty.

Now, on the question of speed, and as proof of the success of the hydraulic propeller, I am justified from letters I have received from

Mr. Dudgeon, and from the Admiralty reports of the trials of the "Waterwitch," in stating that substantial evidence on this point has been obtained. It is true, Mr. Dudgeon constructed the engine of the "Waterwitch," but he is known as the special friend, and the most successful designer of twin-screw vessels, and I believe his vessels have equalled the best speed of the single screw or paddle. And I consider it most fortunate to have obtained the advantage of his ability and generous support in developing this new motive power, knowing that his opinion is devoid of all prejudice.

I wish to call special attention to the fact, that the naval architect must have greater command of speed with the hydraulic propeller than with the screw, because the screw is always limited as to diameter, and supposing unlimited power be given to a screw-engine, as you increase the number of revolutions, the resistance is increased on the bows of the vessel, until the loss by slip gradually increases, and so you arrive at last at a point when the screw is making all slip.

But the turbine has no slip, and you may have several turbines in one vessel; and to whatever extent you increase the boiler power, so you increase the speed, under the law that the power is as the cube of the speed. So, if you wanted to go 20 or 30 knots an hour, the only possible way of attaining it is, by the turbine, because you cannot increase the diameter of the screw, nor can you multiply them; you may increase the power of the engine, but, when you get up to a certain point, the power would be so great, that the screw would be all slip.

The battle between the turret and the broadside principles has been always fought on the merits of gunnery questions alone, but there has been another very important question at issue, and that is, as to the most advantageous distribution of weights; and now the hydraulic propeller presents the same consideration as compared with the screw, only to a much larger extent. The turret principle and the hydraulic propeller, when combined, will solve all difficulties attending the creation of an armour-clad ocean fleet of the line: and I do earnestly hope that before another large vessel is laid down, a total change may take place as to the sea-going qualities our ships are to possess for the future.

For an hydraulic gun-boat, I recommend the *end-on* principle of fighting, as of old, with a heavy gun behind a stout shield, and no attempt of broadside armour protection; the bow rendered unsinkable, before the shield, by partitions filled with cork, to the level of the water-line. I merely mention this because the model on the table happens to represent this principle, and it is what I suggested should be applied to the "Waterwitch." Then, by keeping the stern of the vessel on, towards the enemy, I could always retreat without turning round. My opinion is, that the end-on principle of fighting is a necessity for gun-boats, and that such a gun-boat would prove most mischievous against large vessels for coast defence. That is to say, with that heavy gun, and that thick defensive armour-plated shield, and with the bow protected in that secure manner, I could, with one of these gun-boats, in shoal water, drive off any armour-clad; nor do I think an enemy would

run the risk of exposing so large a vessel to destruction by a small gunboat of such a character. I think, myself, that that character of gunboat will become a very formidable weapon for the defence of our coasts. I am sorry they would not allow me to fit the "Waterwitch" in that way, but the day will come.

In one respect, particularly, I hope that I may be in error, but judging from the reports of Officers in whose opinion I have great confidence, I really do not believe, that, with the exception of the two first that were built, the "Warrior" and "Black Prince," and perhaps the "Achilles," we have an iron-clad in our Navy which could be safely trusted, if placed in the middle of the Atlantic in the winter time, were she to break a screw shaft, and if heavy gales and continual bad weather were to come on. Another thing is, that in action, vessels get their masts knocked away, and then with the screw shaft disabled, they would be at the mercy of the waves, and I really do not know what would become of them.

Some of my remarks may bear the stamp of unsupported doubts and fears, but I am willing to bear the burden of this accusation, and shall be quite content to do so, provided what I have said may have the effect of producing a greater degree of consideration in the future of armour-clad designing, to the matter of the safety of our ships at sea, and to the classification of ships.

I would just refer to what was said by Mr. Reed with regard to my paper, as regards the "Waterwitch." He says:—"With reference to "the hydraulic system, he should be very sorry if what he said should "be construed into an opposition to that system, because it was very "undesirable that a system which had started so well as that had "started, should encounter any prejudiced opposition. In the first "place he thought the twin-screw vessels—he did not mean "Mr. Dudgeon's, for he had not the pleasure of seeing them—with "which the 'Waterwitch' had competed were about the most "wretched specimens of vessels as regards propulsion, that could "possibly be produced." I am sorry Mr. Reed should have said that. First of all he built them himself; and, independently of that, I do not know that that has anything to do with the trial of the two motive powers. He says:—"The 'Vixen' and 'Viper' were little more than "shallow floating boxes, very heavily burdened with armour plating, "of very light draught of water, and with very full bows and sterns, "and he might say that they had the double stern chiefly on the "ground that it gave them more displacement. The 'Waterwitch,' "as compared with those vessels, had this advantage, that whereas "they trimmed afoot by the stern, the 'Waterwitch' had the same "maximum draught, an even keel, which had the effect of enabling "them to fine the lines a little. It could hardly be admitted that a com-"parison between the principle of the 'Waterwitch' and the screw "principle was sufficiently established by the competition between her "and such vessels as the 'Vixen' and the 'Viper.' At any rate the "'Waterwitch' did better than they looked for, and no one could fail "to appreciate many of Admiral Elliot's suggestions as to the advan-"tage of the hydraulic system as compared with the screw." I merely

mention what Mr. Reed says to show that, generally speaking, he rather conveys the impression that the "Waterwitch" was a success.

My reply to what he said was as follows:—"Mr. Reed had endea-"voured to show that the trial of the 'Waterwitch' was not trust-"worthy evidence of success, becuse the 'Vixen' and 'Viper' were, in "his opinion, 'the most wretched specimens of vessels as regards pro-"'pulsion that could possibly be produced, and because the 'Water-"'witch,' although a sister vessel, had both ends shaped alike, and "'was of the same maximum draught, but on an even keel, which had "'enabled them to fine the lines a little.' Now he (Admiral Elliot) "would put it to the naval architects present, whether, as the vessels "were of the same type, it was not as fair a comparative test of the "propellers to do the same work, for the same power exerted in coarse "lined ships, as in those of finer lines? And also he would ask whether "it was possible to obtain finer lines in the 'Waterwitch' than in the other "vessels, with the same length and breadth, and same midship section, "and greater displacement, and the same maximum draught of water? "Comparing the lines of the two vessels, it became evident that the "'Waterwitch" was at a disadvantage in point of form to the 'Vixen' "and 'Viper,' and a very clever naval architect had given a decided "opinion that it was so." Then, with regard to Mr. Dudgeon, I asked, "Whether, considering that his vessels, the 'Medusa' and 'Triton' "were 34 feet longer and 3 feet less draught of water than the "'Waterwitch,' and therefore easier driven vessels, although of the "same type and the same displacement, he did not consider that the "hydraulic propeller had shown equal merits to his twin screw prin-"ciple by comparison of results of speed?" Mr. Dudgeon assented to it.

I will merely mention these remarks of Mr. Scott Russell:—"He "was not known as an advocate of that principle. He had known of "it for two generations, and as far as he knew the relative value of "propellers it stood thus:—That the paddle-wheel, the double-screw, "and the hydraulic propeller were, theoretically, equally good. Out of "them all they could get the same speed, and it was a mere matter of "human ingenuity, in which he had infinite faith, applying each pro-"peller so as to get out of it the special qualities and the speeds "required. He would undertake to say that a hydraulic propeller, a "double-screw propeller, and a paddle-wheel with the same power of "engine, would all give the same speed, but under very different cir-"cumstances, with very different combinations, and with very different "elements of construction. Therefore, he would say to Admiral "Elliot, 'Go on, feel your way, puzzle your brains, get as many "'clever men to work as you can, and go on with your hydraulic pro-"'peller, and I promise you in the end, that you will certainly "'succeed.' I do not say that you will ever get more speed than "you will out of the others, I will not say it will not take you a long "time to get the same speed as the others—I won't say that you have "not a deal of trouble still to take, and a monstrous quantity of "ingenuity still to throw into it before you can get your wheels con-"veniently placed, and before you can get your large orifices for a

"ship of large size so constructed that your machinery shall work "handily, but I promise you, if you go on you will get it."

I have only a few words more in conclusion; I must apologise for the incompleteness of my preparations for reading this paper, but I trust I have laid before you sufficient evidence of the importance of this subject to secure from you an interest in its early development. At present the fate of this invention is in the hands of the Admiralty; they, having in its earlier stages, when all was dark and suspicious, considered it of sufficient importance to make so costly an experiment as the "Waterwitch." I do trust that now so much success has attended this first trial in a war vessel, they will not delay in making a further trial in a larger vessel, with greater power, intended for high velocity. I ask for one of the new corvettes of the "Blanche" class, 1200 tons and 350-horse power. This would be a most satisfactory trial, and four of those vessels are to be built this year. I wait in hopes of a favourable reply to my request.

The CHAIRMAN: This is a subject that interests us all very much, and I have no doubt there are many gentlemen here who will be glad to give an opinion upon it. I will ask Admiral Elliot to take a note of the various points that may be raised, so as to enlighten us as to the merit of the objections that may be made. For myself I would wish to ask him two questions: One is whether the discharge of the water from a turbine, if under water, would not give a greater power of propulsion than if it were at the water's edge and exposed, as having a greater resisting medium to act against? Next, when he spoke of the ramming, how far we should be able to have a solid fabric, with rudders, at the two extremities of the ship, capable of ramming an enemy satisfactorily, either one end or the other? If we can do that, it would be a very great advantage. But the rudder, I think, would be rather antagonistic to the solidity of the two ends. Those are the only two points I would like to ask him about.

Captain C. H. SIMPSON, R.N.: I would like to ask one question. Admiral Elliot has stated that there is no slip on the hydraulic principle. I always had an idea that the slip was the velocity of a propeller over that of the vessel. In the hydraulic propeller the water is the propeller. I would wish to ask if the water issues from the tube or nozzles with greater velocity than the vessel moves? and if it is necessary that it should do so?. Because if it moves at greater velocity, it appears to me that the excess of velocity of water over the velocity of the ship must be the slip. I would also like to ask why there is this extraordinary power displayed in the hydraulic principle in stopping suddenly? I wish to ask what is the cause of that power? It is a special thing belonging to the hydraulic, and, therefore, must have a special cause. My object in asking that question is, because I think that the same cause that gives that power to the hydraulic, is the very cause that will, at high speeds, make it inferior to other propellers.

Admiral Sir JAMES HOPE: How do you propose to protect the propeller?

Admiral ELLIOTT: With a shield.

Sir JAMES HOPE: Is there any position for these propellers which would be more advantageous than another for speed?

Admiral ELLIOT: We think the propeller just above water is the best position. We tried it in the "Waterwitch" first of all, with the nozzle out of water; then we sunk the vessel down, and tried it with the nozzle in the water, completely immersed; and having compared the speed at light draught and at deep draught, as against the speed of the "Vixen" at the two draughts, we found, as far as we could ascertain, it did not matter at all. But the reason we think it better to have the nozzle just above the water is, that the freer the discharge of water, the better for the re-actionary power by which you obtain your speed to go ahead. If you dis-

charge your water into a vacuum, by comparison, you will get the greatest advantage from it. Therefore, if water, by being discharged against water, is retarded, we think it is rather a hindrance. If you close the mouth altogether, no action will take place; if you open it slightly, a small action is obtained, and small speed; the freer it goes out the better. But we do not believe that there is anything so important in it but that it can be put down under water.

Commander COLOMB, R.N.: It is rather late, but I should like to make one or two remarks. Admiral Elliot somewhat disparaged the Devonport experiments, and said they were not fathered by the inventor. That is perfectly true. But at the same time, the Devonport experiments were sufficient to show the value of the mode of propulsion in a certain degree, and I believe gave a very considerable push to the invention at the Admiralty. The experiments were tried in a gun-boat of 60 horse-power, the "Fan," which expelled the water driven by the ordinary engines of the ship. The velocity of discharge from the pipe was 2,190 feet per minute, and the loss, which would be actual slip, or friction, or whatever you call it, was 205 feet per minute. The dynamic pressure, at that number of revolutions, with an indicated horse-power of 173, was 1,442 lb. It was found, and this may be an answer to the Chairman's question to a certain extent, that the dynamic pressure increased from 150 lb. to 200 lb. when the nozzle was placed below the water. I am not going to attempt to explain why it should be; I cannot see myself why it should be. Though there appears to be from these experiments some slight friction, yet I believe that it is wrong altogether to look at the question as involving friction, because the power in this mode of propulsion is given by pressure; and the only way to understand it, I believe, is to consider it as a pressure, and as a release of pressure. The travel of the fan of the pump is sufficiently great to generate a certain pressure in the pipe leading to the outside of the ship. Now, pressure on all sides of that pipe is equal, necessarily. You open a portion of the pipe, and you take off that, by opening, the pressure which previously existed there, and you have, as the remainder, the pressure upon the part which is opposite to it; and that is how you get your power. If you take friction into account, I think you immediately get into a maze of difficulties from which I see no possible exit. Admiral Elliot made a great many remarks about rolling. I cannot say I know very much about the subject, still I have looked a little into it, and I have had the opportunity of witnessing a practical contradiction to some remarks which the gallant Admiral made. He said that he thought rolling came in with the steam-engine. Now, I have served in a great many ships, but the heaviest roller I ever served in, without exception, or ever expect to serve in, was a Symondite brig. The gallant Admiral also expressed it, as a certainty almost, that the placing the weights at the extreme of the beam, as they are placed now, with heavy guns and iron-plating, necessarily increased whatever rolling powers the ship might previously have had. The other night I quoted here some experiments of Admiral Paris. He tried very accurate experiments in a small vessel, and he found that as he placed the weights towards the extreme of the beam, so the rolling of that vessel decreased. I do not believe that the rolling of our ships has very materially increased, except in the case of wooden ships of the "Caledonia," "Royal Alfred," "Royal Oak" class. In the case of the "Warrior," I happened to be present during her first official trial, and I recollect that her rolling power, as compared with that of the "Revenge," which was a very steady ship, was only 20 degrees to 17 degrees. But I am inclined to demur altogether to the records of the rolling of our ships. I am inclined to demur to them, because we have never had any proper instruments for measuring the rolls. On board the ship I was in in the Channel Fleet, we tried from time to time to get at the ideas of different Officers as to the rolling of the ship at particular times, and we found that those ideas varied immensely. I am very glad indeed to get another confirmation of my idea that the ram is to be our future weapon; and in corroboration of what Admiral Elliot has spoken of as regards the necessity of arming the stern for ramming, as well as the bow, I may say that the Russian Admiral, Boutakov, has pointed out in his work on naval tactics the great necessity for this. It is a point he has urged very strongly, and I agree with him; and I agree with Admiral Elliot also that it is a most important matter. I have only one word to say about another advantage of the hydraulic which

I did not gather, that Admiral Elliot brought forward. I look upon it that the hydraulic propeller will enable us to increase the beam of ships, and thereby reduce their length, while at the same time retaining their mass. That is, we may increase the lateral area of the midship section, while we take off from the vertical one, and thereby we shall get a handier ship, at a lighter draught of water, to do the work which is now done by a longer ship, with a narrow and deep midship section.

Captain RICHARD WELLS, R.N.: I should like to ask whether the space taken up by the engine-room, the turbine-wheel, and the well for receiving the water, is greater in vessels of a similar class than the space taken up by the engine-room and the machinery in an ordinary screw?

Commander POLAND, R.N.: In the case of getting on shore, I should fancy the power of the turbine will be entirely destroyed, or nearly so, should the vessel land on sand, which would fill up the holes in the bottom.

Admiral ELLIOT: The first question, I think, was with regard to the discharge of the water above the water-line and below the water-line—whether it was an advantage? I think that was the question that was put. I have just described it to Admiral Sir James Hope that it is a question which is undecided; there are different opinions upon it. An eminent French engineer makes it out that it is better under water; that increased power and increased speed will be obtained. Mr. Ruthven thinks the contrary; but as regards the effect of rolling motion, it will probably be better that the discharge-pipes should be so low down as not to roll out of water. But it is a question not decided. The next question was with regard to the weakness of a double-ended vessel, in consequence of the rudder. I think if the end is shaped so that the blow is struck here (pointing), if that is backed by the vessel, particularly where the deck is, that if the blow is struck there, I do not think you will weaken it by having the rudder here. I think the rudder may be lower down than this is. This rudder has a much larger surface than the ordinary rudder of a ship. But you may lower the rudder and take a piece off the top, and you will still have sufficient surface for steering. I think that that weakness may be reduced. I do not think it will signify; it is a question for the naval architect to arrange. But I do think you will be able to have a perfect ram at both ends, and have a rudder underneath; by building it for the purpose. I should say that, in the case of ramming, we have seen enough of it to know, that this piece the spur should not be a part of the vessel at all, but that it should be capable of being taken off, leaving the vessel intact afterwards, not to open the vessel out if you lose your spur. The next question was with regard to the power of stopping the hydraulic, as compared with the screw. I could not quite understand that question. The whole power of the engine is immediately applied, in almost a second or a few seconds, to stop and to go astern. You merely reverse the nozzle valve, which is like a tap in a beer cask, and the water, instead of flowing out in one direction, flows out in the other, so that the whole force is exerted to drive the ship the other way. If you could instantaneously reverse the paddle-wheel you might get the same power there, but you cannot do that suddenly. It is quite the reverse with the screw. When you come to stop a ship going ten knots, and to turn your screw astern, in the first place it is a long operation. It is a great strain upon your engines; and if you look to the shape of the screw, and the effect it has, you would find that if you were to go as fast as you could astern, you would produce little effect. You might go 14 knots ahead, but I question whether your ship would go 4 or 5 knots astern; and certainly you cannot steer, because directly you come to back with the screw, the ship's bow is sure to go (according as it is a right-handed or a left-handed screw) in the opposite direction. I found in narrow channels I could not use the screw astern. Directly I did, it threw my bow round, and it would have put me right ashore. I remember also in the Baltic a ship attempted to back with her screw, to keep astern of the Admiral, and she run her bow right into the flag-ship's quarter.

Captain SIMPSON: Then the paddle would have the same power in stopping as the hydraulic?

Admiral ELLIOT: I think it depends upon how the paddle floats are placed for going ahead. If they are vertical, of course they would have the same power; but you would still have to disconnect, reverse your wheels, and that is a long operation.

Captain SIMPSON: Reverse the engines?

Admiral ELLIOT: Reverse the engines. You have a certain amount of machinery to set in motion. The next question, I think, was with regard to the slip, whether the water was discharged quicker than the ship goes. The water in the "Waterwitch" is discharged at about double the speed the ship is going, whatever the speed of the vessel may be. But there is no slip; and the best proof of it is that you obtain the same result with the same power.

Captain SIMPSON: But if the water is the propeller, and the propeller is going with greater velocity than the vessel, surely the excess of the velocity of the propeller over that of the vessel, is slip?

Admiral ELLIOT: There is no such thing as slip nor loss of power, as supposed by Captain Simpson. The power is obtained by reaction from the water discharged. Whatever the speed of the ship, it does not lessen the effect of the reaction due to the amount of pressure produced in the discharge pipe. By way of comparison, if a ship were going 50 miles an hour, and you fire a gun right astern, the speed of the ship does not lessen the recoil of the gun. Nor does it lessen the recoil, or rather the reaction produced by the discharge of water from the discharge pipes.

The Devonport experiment I should like to refer to. What I said was, that the experiment was made without any reference to the patentees. No question was ever asked of the patentees, as to how that experiment should be carried out, but I can assure my good friend Captain Colomb, that his information to-day is the first information I ever received, either by word of mouth, or by letter, as to what the result of that experiment was. I was never told. I did not know whether it was successful, or whether it was the reverse. It was kept very secret. You have let out a great secret, and I am glad to hear the experiment had such a good result. There was no report made to me; and as I said, Mr. Ruthven went down, and seeing it was no child of his, he abandoned it. But I think that when the Admiralty ordered the experiment to be made, we might have been consulted as to the mode of making it. A question I should like to answer is, with regard to the rolling of the Symondite brig. I could understand the Symondite brig rolling. I have been in a Symondite brig myself, and I should like to ask a counter-question to that, which is, "Did you ever go in a Symondite after she had an engine in?" because, I think if you did, you would find she rolled a great deal more. We have only to take the "Colossus," and vessels of that class, in which an engine was put, and it was acknowledged that they rolled a great deal more afterwards. I think that speaks for itself, that it is the weight of the engine that causes the rolling. Then, with regard to the spreading weights out to the side, having stopped the rolling. I expect if we had analysed that, we should find that the weights that were put to the side, was ballast that was "winged" up. I know that in many instances where they "winged" up ballast in Symondite ships, they found it reduced the rolling. But it was not because the ballast was "winged" up that it reduced the rolling; but it was because you raised the centre of gravity, and that reduced the rolling.

Captain COLOMB: The balance was on the same level, throughout.

Admiral ELLIOT: I go upon the broad principle that centralised weights decrease the leverage and reduce the rolling, *cæteris paribus*. Then with regard to the question of increasing the beam in an hydraulic vessel, I do not see that the hydraulic facilitates the increase of the beam, but it does the reduction of the draught of water. I think in a light-draught-of-water vessel, you can get greater speed than with the screw; as you decrease the draught of water, you injure the power of the screw. With regard to that, the turbine need not be under water. If the bottom of the turbine is in the water, the moment you set it in motion you cause a vacuum, and the pressure outside will fill it up. Therefore, in very light draught of water, you can get great velocity, whereas you cannot do so by any screw. Mr. Dudgeon, in his recommendations to the Brazilian Government, speaks of that. He says, if you want great speed in a light-draught-of-water vessel, I must take the turbine for it. With regard to a question as to the relative spaces required for the hydraulic engines and those for the screw machinery in vessels of the same class, the "Waterwitch" engine is placed in exactly the same space as the engine of the "Vixen" and "Viper." When I found that the screw passage was available, was

a space that I was going to lose, I asked for that same area to be given into the engine-room. It is added to the stoke-hole, not to the engine-room. The engine is exactly in the same place. But if you go and measure the stoke-hole, you will find there is a very fine stoke-hole, adding a couple of feet for the stokers. But the principle is weight for weight, space for space, price for price, and speed for speed. Now, there is another question that I am very glad has been asked me, about getting on shore. I would not speak of it, because I thought it might be put. We must first of all ask, what do we go on shore upon? If we go on shore on rocks, I do not think anybody will say that the water will not come in. But as the canal of the turbine forms a double bottom, and as there are additional kelsons, the strongest part of the ship is, where the canal is. If we go on shore on mud, we know quite well, that if you put the hydraulic vessel on mud, you can work your engine; it is mud and water that comes through, and you can soon work a hole under the vessel—there is nothing to stop it. Sand would do the same thing. We hear of getting vessels off now, by stirring up the sand below, and pumping it out of the vessel. Here is a turbine that will do it for you. If you make a hole under the ship on a sand bank, the sand will crumble in; but I think this turbine will some day be found to get a vessel so circumstanced off. If you put your vessel on stiff clay, perhaps you could not stir that clay, but there is generally ooze on the top of the clay. But supposing there is any objection to the canal being under the bottom of the vessel, we could just as well, instead of letting water up into the turbine by the canal from below, let it into the turbine from the side. What we asked to do the other day with a wooden ship was to put it there. There is no reason in the world why you should not open the side, and make the canal on each side of the vessel. I think that I have now answered all the questions.

Captain INGRAM, R.N.: Could you drive your ship through a heavy head sea?

Admiral ELLIOT: I think that question was answered just now, that so far as the turbine is concerned, the power is always the same.

Captain INGRAM: Would the head sea check you sooner than it would check the screw?

Admiral ELLIOT: I should say, certainly not, because the screw is out of the water, and you lose a portion of your power; but with the turbine the same power is always being exerted.

The CHAIRMAN: I am loth to stop any further questions, but the hour is very far advanced, and I think we are prepared now to close the discussion. We have all had an opportunity of speaking; but I think there is one thing that all agree upon, whether we think the plan is successful or not, that is, that we must be very grateful to Admiral Elliot for bringing it forward, and for the way in which he has put the various facts before us. I must say, there is much to learn; I, at least, have learned a great deal myself, and I hope we have all learned much from the paper. Even the remarks that have been made, have elicited what is very valuable. As I said before, we are all very much indebted to Admiral Elliot for his admirable paper.

Admiral ELLIOT: I have only to return my grateful thanks for the patient manner in which you have heard what I have had to say.

LECTURE.

Friday, June 28th, 1867.

COLONEL PHILIP J. YORKE, F.R.S., in the Chair.

PRIMITIVE WARFARE: ILLUSTRATED BY SPECIMENS FROM THE MUSEUM OF THE INSTITUTION.

By Colonel A. LANE FOX, Grenadier Guards.

ALTHOUGH it is more in accordance with the purposes for which this establishment has been organised, that the Lecture-room should be devoted chiefly to subjects of practical utility connected with the improvement of our military system and the progress of the mechanical appliances, the organization, and general efficiency of our Army and Navy, than to the efforts of abstract science, yet the fact of your possessing in the three large apartments that are devoted to your armoury, one of the best assortments of semi-civilized and savage weapons that are to be found in this country, or, perhaps, in any part of the world, is sufficient to prove that it is not foreign to the objects of the Institution that the science of war should be ethnographically and archæologically, as well as practically, treated.

The requirements of our advancing age demand that every vein of knowledge should be opened out, and, in order to make good our title to so interesting a collection of objects as that comprised in, what may very properly be called our ethnographical military department, it should be shown that, whether or not the subject may be considered to fall within the ordinary functions of the Society, our Museum is made available for the purposes of science.

The age in which we live is not more remarkable for its rapid onward movement than for its intelligent retrospect of the past. It is reconstructive as well as progressive. The light which is kindled by the practical discoveries of modern science, throws back its rays, and enables us to distinguish objects of interest, which have been unnoticed in the gloom of bygone ages, or passed over with contempt.

Men observe only those things which their occupations or their education enable them to understand and appreciate. When a savage is introduced on board the deck of a European vessel, he notices only those objects with the uses of which he is familiar—the sewing of a

coat, a chain or a cable at once rivets his attention, but he passes by the steam-engine without observation, and if a work of art is forced upon his notice, he is unable to say whether it represents a man, a ship, or a kangaroo!* So in past ages the flint implements of the drift, the parents of all our modern implements, whether for war or handicraft, must have been carted away in hundreds, unobserved, and in ignorance that these inconspicuous objects would one day be the means of upsetting the received chronology of our species.

Whilst, therefore, we devote our energies chiefly to progress, and fix our attention upon the present and future of war, it cannot fail to interest those who are actively engaged in the duties of their profession, if we occasionally take a glance backward and see what recent discoveries have done towards elucidating its origin and early history.

It might, perhaps, assist a right understanding of the principles on which the weapons and implements of savages deserve to be studied, if I were to notice some of those great questions respecting the origin of our species, and man's place in nature, which the investigations of science have been the means of raising in our day. I need hardly say that the rude implements, which I am about to describe, are of little practical interest in themselves, as models for instruction or imitation. We have no need of bows and arrows in the existing state of war, and if we did require them, the appliances of modern times would enable us to construct them in far greater perfection than could be acquired by any lessons from savages. These weapons are valuable only, in the absence of other evidence, from the light they throw on pre-historic times, and on those great questions to which I have alluded, and from their enabling us to trace out the origin of many of those customs which have been handed down to us by past generations.

As, however, the discussion of these interesting subjects would lead me into matters that are hardly suited to the Lecture-room of this Institution, I must pass over the consideration of them with a few brief remarks.

In so doing, I may appear to postulate some opinions upon points that are still the subject of animated controversy in the scientific world. But it would require a far broader field of investigation than is here afforded me, in order to treat these inquiries successfully, and to adduce all the evidence that would be necessary to support the hypotheses put forward; and I am anxious to devote no greater space to these preliminary remarks than is necessary to point out some of the main features of interest that are involved in the particular study which forms the subject of my lecture.

We are apt to speak of the creation of the universe as a thing of the past, and to suppose that the world, with all the varied life upon it, previous to man's appearance, having been created for his especial happiness and supremacy, was afterwards left to his control and government. But this view of the subject belongs to an age in which the laws of nature in their all-sufficiency and completeness were but little

* Beechey's Voyage to the Pacific, p. 298. Oldfield's Aborigines of Australia. Transactions of the Ethnological Society, vol. iii, new series, p. 227.

studied and appreciated. Modern science finds no evidence of any such abandonment of the universe to man's jurisdiction. The more comprehensively the subject is viewed, the more restricted appear to be those limits over which the free will of mankind is permitted to range, and the more evident it becomes, that in his social advancement, his laws, arts, and wars, he moves on under the influence and development of those same laws which have been in force from the very first dawn of creation. The lower the archæologist searches in the crust of the earth for the relics of human art, the more faint become the traces of that broad gulf, which in our times appears to separate man from the brute creation. In all the numerous and varied offsprings of the human intellect, in the arts, and even in speech, the more we investigate and trace them back, the more clearly they appear to point to a condition of the human race in which they had no existence whatever. The great law of nature, "natura non facit saltum," was not broken by the introduction of man upon the earth. He appears to have been produced in the fulness of time, as the work of creation required a more perfect tool, and to have ameliorated his condition, only as the work to be performed became more complicated and varied, just as in the hands of man, the rougher tool is employed for felling, and the finer tool for finishing and polishing.

By this view we come to look upon even the most barbarous state of man's existence, as a condition, not so much of degradation, as of arrested or retarded progress, and to see that, notwithstanding many halts and relapses, and a very varied rate of movement in the different races, the march of the human intellect has been always onward.

As in the lower creation, we find no individuals that are capable of self-improvement, though some appear, by their imitative faculties, to contain within them the germs of an improving element, so the aboriginal man, closely resembling the brutes, may have passed through many generations before he began to show even the first symptoms of mental cultivation, or the rudiments of the simplest arts; and even then his progress may have been, at first, so slow, that it is not without an effort of imagination that the civilized races of our day can realise, by means of the implements which he has left us, the minute gradations which appear to mark the stages of his advancement. This appears to be the view taken by Sir Charles Lyell in his "Antiquity of Man," when, in comparing the flint implements found in the higher and lower level gravels of the valley of the Somme, he arrives at the conclusion, "that the state of the arts in those early times remained stationary for an almost indefinite period." "We see," he says, "in "our time, that the rate of progress in the arts and sciences proceeds "in a geometrical ratio as knowledge increases, and so, when we carry "back our retrospect into the past, we must be prepared to find the "signs of retardation augmenting in a like geometrical ratio. So that "the progress of a thousand years, at a remote period, may correspond "to that of a century in modern times, and in ages still more remote, "man would more and more resemble the brutes in that attribute "which causes one generation exactly to imitate, in all things, the "generation which preceded it."

In order to understand the relationship which the savage tribes of our own time bear to the races of antiquity, it is necessary to keep in view that, neither in historic nor pre-historic times is there any evidence that civilization has been equally or universally distributed; on the contrary, it appears always to have been partial, and confined to particular races, whose function it has been by means of war and conquest, to spread the arts amongst surrounding nations, or to exterminate those whose low state of mental culture rendered them incapable of receiving it.

Assuming the whole of the human species to have sprung originally from one stock, an hypothesis which, although disputed, appears to me by all existing evidence and analogy of known facts, to be the most reasonable assumption, the several races appear to have branched off at various and remote periods, many of them, perhaps, previously to the present geographical arrangement of land and water, and to have located themselves in the several regions in which they are now found, in a state which probably differs but little from that in which they existed at the time of their separation from the parent stem.

Each race, after separation, shows evidence of arrested growth; and, finally, the intellect of the nation fossilizes and becomes stationary for an indefinite period, or until destroyed by being brought again in contact with the leading races in an advanced stage of civilization, precisely in the same way that the individuals composing these races, after propagating their species, stagnate, and ultimately decay, or, in a low state of savagery, are often destroyed by their own offspring.

Taking a comprehensive view of the development of civilization, it may be compared to the growth of those plants whose vigour displays itself chiefly in the propagation of their leading shoots, which, overtopping the older and feebler branches, cause them to be everywhere replaced by a fresh growth of verdure. The vegetable kingdom thus furnishes us with the grand type of progress; continuity and bifurcation are principles of universal application, uniting the lowest with the highest created thing.

The analogy of tree growth has been frequently employed in relation to natural phenomena, and it may very well be taken to explain the distribution of the human race, and the progress and expansion of the arts. It forms the key to the Darwinian theory of natural selection, which is essentially monogenistic in its application to the origin of the human race.

Thus the existing races of mankind may be taken to represent the budding twigs and foliage, each in accordance with the relative superiority of its civilization, appertaining to branches higher and higher, placed upon the great stem of life.

So little is as yet known of the early history of any but our own family of nations, that in the existing state of knowledge, the attempt to classify and place them on their proper branches, must be attended with much difficulty, and great liability to error. However, by arranging the existing races according to their civilization, a tolerably correct judgment may perhaps be formed as to the value of this system of classification, if we distribute them with those of antiquity in some

two or three broad divisions. The Caucasian races of modern Europe, for example, may be said to bear to their ancestors of the historical period the same relationship that geologists have shown the existing mammalia of our forests bear to the mammalia of the tertiary geological period. The semi-civilized Chinese and Hindoos, in like manner, may be classed with the races of ancient Assyria, Egypt, and other nations immediately prior to the first dawn of history, the civilization of which nations they still so greatly resemble, and appear to have retained, in a state of retarded progress from those ages to our own. A third division may perhaps be made of the Malay, Tartar, and African negro nations, which though now in an age of iron, may, by the state of their arts, and more especially by the form of their implements, be taken as the best representatives of the pre-historic bronze period of Europe, towards which they appear to hold the same relationship that the fish and reptiles of our seas bear to those of the secondary geological period. In a fourth division may be included the still more barbarous races of our times, the Australian, Bushman, and hunting races of America, whose analogy to those of the stone age of Europe may be typified by that of the mollusca of recent species to the mollusca of the primary geological period.

In all these existing races, we find that the slowness of their progression and incapacity for improvement is proportioned to the low state of their civilization, thereby leading to the supposition that they may have retained their arts with but slight modification from the time of their branching from the parent stem, and may thus be taken as the living representatives of our common ancestors in the various successive stages of their advancement.

Many examples of this immobility on the part of savages and semi-civilized races may be given.

Throughout the entire continent of Australia the weapons and implements are alike, and of the simplest form, and the people are of the lowest grade. The spear, the waddy, and the boomerang, with some stone hatchets, are their only weapons; but amongst these it has been noticed that, like the implements of the drift, there are minute differences, scarcely apparent to Europeans, but which enable a native to determine at a glance to what tribe a weapon belongs.* This, whilst it proves a tendency to vary their forms, shows at the same time either an incapacity or, what answers the same purpose, a retarding power or prejudice, which prevents their effecting more than the smallest appreciable degree of change. In the island of Tahiti, Captain Cook was unable to make the natives (a superior race to the Australians) appreciate the uses of metal, until he had caused his armourer to construct an iron adze (Plate XLVIII, fig. 1 *a*) of precisely the same form as their own adzes of basalt (Fig. 1 *b*).† After that, metal tools came into general use amongst them, though their old forms are in a great measure preserved to this day. When during the American

* A. Oldfield on the Aborigines of Australia. Trans. Ethno. Soc., vol. iii, p. 261, 267.

† See the figures in Meyrick's Ancient Arms, &c., pl. cxlix.

war, the English endeavoured to utilise the Indians by arming them, they were compelled to construct for them tomahawks after their own pattern, having a pipe in the handle (Fig. 2). When the Purus Indians of South America receive a knife from Europeans they break off the handle, and fashion the knife according to their own ideas, placing the blade between two pieces of wood, and binding it round tight with a sinew.* The natives of Samoa now use iron adzes, constructed after the exact pattern of their ancient stone ones.† The Fije Islanders, though they have now the means of obtaining good blades and chisels from Sheffield, and axes from America, prefer plane irons to any other form of implement, because they are able to fix them by lashing them on to their handles in the same fashion as the ancient stone adzes of their own manufacture, which they resemble.‡ The Andaman Islanders use the European metal that falls into their hands, only to grind it down into spear- and arrow-heads of the same form as their stone ones. The same applies to the whole of the Aborigines of North and South America, which have stood by, for nearly three centuries, passive spectators of the arts of Europeans, without attempting to copy them. Mr. Crawfurd, in his history of the Indian Archipelago, comments on the obstinate adherence of the Javanese to ancient customs, in accounting for the kris having been retained by them long after the causes which produced that peculiar weapon had ceased to operate. Tylor, in his account of the Anahuac, observes upon the preservation of old types amongst the present inhabitants of Mexico, which have remained almost unchanged from generation to generation, enabling the historian to distinguish clearly those which are of Aztec from those which are of Spanish origin.§ Herodotus describes the spears carried by the Ethiopians in the army of Xerxes as being armed with the sharpened horn of the antelope.‖ Consul Petherick found still in use by the Djibba negroes more than two thousand years after, these identical spears, armed with the straightened and sharpened horn of the antelope, and their other weapons also resembled in character those described by Herodotus, although they had passed from the stone weapons then used, into an age of metal.¶ The Scythian bow (Fig. 3) is the bow still used by the whole of the Tartar races (Fig. 4). The Celt of the Tartar, and the Celt and sword of the Negro (Fig. 5) is still the Celt and sword of the European bronze period (Fig. 6), and this resemblance is not confined to the general outline of the weapons, but extends to the style and patterns of ornamentation. The same identity of form exists between the Manillas (Fig. 7) used as a medium of exchange in the Eboe country of West Africa and the so-called penannular rings or ring money (Fig. 8) of gold and bronze that are found in Ireland, and which, with some modifications, belong also to Germany and the

* Klemm-Werkzeuge und Waffen, p. 159.
† Turner, Nineteen Years in Polynesia, p. 262.
‡ Fije and the Fijeans, p. 78.
§ Anahuac, by E. B. Tylor, p. 70.
‖ Rawlinson's Herodotus, vol. iv, p. 69.
¶ Petherick's Travels, p. 360.

Swiss Lakes. The corrugated iron blade of the Kaffir assegai, a section of which is shown in Fig. 9, and which is used also in Central and West Africa, is identical with those found in the Saxon graves (Fig. 10), and is intended to give a spiral motion to these missiles. Chevalier Follard observes that the Gauls were remarkable for the tenacity with which they clung to their ancient customs, while the Romans, their conquerors, are mentioned by all historians as peculiar in their time for the facility with which they adopted the customs of others, and developed their own. In modern Europe, the Gypsies have also been noticed as being distinguished from the Europeans in all the various localities in which they are found, for their remarkable adherence to especial arts, savouring of an extinct civilization. Amongst the Chinese and Hindoos, the conservatism which has caused them to remain for ages in nearly the same condition is too well known to require comment. It will, however, be remembered, in illustration of the fact, that customs of minor importance often survive great political changes, and serve to keep up the continuity that would otherwise be broken; that after the Manchu Tartars had conquered and established themselves in the Chinese territory, they were nearly driven again from the country, on account of their forcing upon the subject people, the custom of wearing pigtails, after the fashion of their conquerors, showing how difficult it is to ingraft upon an alien race, customs that are not indigenous.

These, and many other notices of a similar character that are to be found in the pages of travel, establish it as a maxim, that the existing races, in their respective stages of progression, may be taken as the *bonâ fide* representatives of the races of antiquity; and, marvellous as it may appear to us in these days of rapid progress, their habits and arts, even to the form of their rudest weapons, have continued in many cases, with but slight modifications, unchanged throughout countless ages, and from periods long prior to the commencement of history. They thus afford us living illustrations of the social customs, the forms of government, laws, and warlike practices, which belonged to the ancient races from which they remotely sprung, whose implements, resembling, with but little difference, their own, are now found low down in the soil, in situations, and under circumstances in which, alone, they would convey but little evidence to the antiquary, but which, when the investigations of the antiquary are interpreted by those of the ethnologist, are teeming with interesting revelations respecting the past history of our race, and which, in the hands of the anthropologist, in whose science that of antiquity and ethnology are combined with physiology and geology, is no doubt destined to throw a flood of light, if not eventually, in a great measure, to clear up the mystery which now hangs over everything connected with the origin of mankind.

That such a combination of the sciences should have been brought about so opportunely in our days, appears to me to be one of those many indications of an overruling power directing in the aggregate the minds of men, and which must, at all times, strike even the most superficial observer of nature; for there can be little doubt that in a few

years all the most barbarous races will have disappeared from the earth, or will have ceased to preserve their native arts.

The law which consigns to destruction all savage races when brought in contact with a civilization much higher than their own, is now operating with unrelenting fury in every part of the world. Of the aborigines of Tasmania, not a single individual remains; those of New Zealand are fast disappearing. The Australian savage dies out before the advancing European. North and South America, and the Polynesian Islands, all tell the same tale. Wherever the generous influences of Christianity have set foot, there they have been accompanied by the scourge. Innumerable, and often unseen causes, combine in effecting the same purpose; diseases which are but little felt by Europeans, act as plagues when introduced into uncivilized communities, and cause them to fall before its ravages, like wheat before the sickle; and the vices of civilization, taking a firmer hold of the savages than its virtues, aid and abet in the same work. The labours of the missionary, if they have produced no other benefit, have been useful in teaching us the great truth, that notwithstanding the philanthropic efforts of the intruding race, the law of nature must be vindicated. The savage is morally and mentally an unfit instrument for the spread of civilization, except when, like the higher mammalia, he is reduced to a state of slavery; his occupation is gone, and his place is required for an improved race. Allowing for the rapidly increasing ratio in which progress advances, it is not too much to assume, that in half a century from the present time, savage life will have ceased to have a single true representative on the face of the globe, and the evidence which it has been the means of handing down to our generation will have perished with it.

When we find that the condition of the aboriginal man must have been one of such complete inanity as to render him incapable of spontaneously initiating even the most rudimentary arts, it follows as a matter of course that in the earliest stages of his career, he must, like children of our own day, have been subject to compulsory instruction. And in looking to nature for the sources from which such early instruction must have been derived, we need not, I think, be long in coming to the conclusion, that the school of our first parents must be sought for in his struggles for mastery with the brute creation, and that, consequently, his first lessons must have been directed to attaining proficiency in the art of war.

Hence it follows that it is to the lower animals that we must look for the origin of all those branches of primitive warfare which it is the object of this lecture to trace out. Nor indeed shall we fail to find abundant evidence that there is hardly a single branch of human industry which may not reasonably be attributed to the same source.

The province of war extends downward through the animal kingdom, shewing unmistakeable evidence of its existence in forms offensive and defensive, differing but little from those of the human era, through the unnumbered ages of the geological periods, long prior to man's advent, proving, beyond the possibility of doubt, that from the

remotest age in which we find evidence of organised beings, war has been ordained to an important function in the creative process.

Judging by results, which I apprehend is the only true method of investigating the phenomena of life, three primary instincts appear to have been implanted in nearly all the higher animals:* alimentiveness, for the sustenance of life; amativeness, for the propagation of species; and combativeness, for the protection of species, and the propagation by natural selection of the most energetic breeds; on which latter subject much important information has been given to the world by Mr. Darwin, in his celebrated work on the origin of species.

Much might, I believe, be said on the connection which subsists between these functions, all of which are, in some form or other, necessary to a healthy condition. Suffice, however, to observe, that as regards the dawn of an Utopia, in which some men who think themselves practical, appear to indulge; whether we study the subject by observing the uses to which animals apply the various and ingeniously constructed weapons with which Providence has armed them, or whether we view it in relation to the prodigious armaments of all the most civilised nations of Europe, we find no more evidence in nature, of a state of society in which wars shall cease, than we do of a state of existence in which we shall support life without food, or propagate our species by other means than those which nature has appointed.

The universality of the warlike element is shewn in the fact, that the classification of the weapons of men and animals are identical, and may be treated under the same heads.

Many constructive arts are brought to greater perfection in animals by the development of faculties, especially adapting them to the peculiar implements with which nature has furnished them, than can be attained by man, and especially by the aboriginal man, whose particular attribute appears, by all analogy of savage life, to have been an increase of that imitative faculty which, in the lower creation, is found only in a modified degree in apes.

The lower creation would thus furnish man not only with the first elements of instruction, but with examples for the improvement of the work commenced, or to use the words of Pope:—

> "From the creatures thy instruction take,
> "Thy arts of building from the bee receive;
> "Learn from the mole to plough, the worm to weave;
> "Learn from the little nautilus to sail,
> "Spread the thin oars, and catch the driving gale;
> "Here, too, all forms of social reason find,
> "And hence let reason late instruct mankind."†

In the art of war, as we shall see, he would not only derive his first instruction from the beasts, but he would improve his means of offence

* In adopting the nomenclature of phrenology, I am not to be understood as advocating strictly the localization of the faculties which phrenology prescribes. The mind doubtless consists of a congeries of faculties, and phrenology affords the best classification of them that has yet been devised.

† Pope's Essay on Man, epistle iii.

and defence from time to time by lessons derived from the same source.

It therefore appears desirable that, before entering upon that branch of the subject which relates to the *progress* and *development* of the art of war, I should point out briefly the analogies which exist between the weapons, tactics, and stratagems of savages and those of the lower creation, and shew to what extent man appears to have availed himself of the weapons of animals for his own defence.

In so doing the subject may be classified as follows :—

Classification of the Weapons of Animals and Savages.

Defensive.	Offensive.	Stratagems.
Hides.	Piercing.	Flight.
Solid plates.	Striking.	Concealment.
Jointed plates.	Serrated.	Tactics.
Scales.	Poisoned.	Columns.
	Missiles.	Leaders.
		Outposts.
		Artificial defences.
		War cries.

Firstly, with respect to the combative principle itself. The identity of this instinct in men and animals may be seen in the widely-spread custom of bating animals against each other, a practice which is not derived from any one source, but is indigenous in the countries in which it prevails, and arises from the inherent sympathy which exists between men and animals in the exercise of this particular function.

In the island of Tahiti, long before the first European vessel was seen off their shores, the inhabitants were accustomed to train and fight cocks, which were fed with great care, and kept upon finely-carved perches.* Cock-fighting also prevails amongst the Malays, Celebes, and Balinese. The Javanese fight their cocks like the Mahommedans of Hindustan, without spurs; the Malays, Bugis, and Macassars with artificial spurs shaped like a scythe.† It also prevails in Central Africa, Central America, and Peru. The Sumatrans fight their cocks for vast sums; a man has been known to stake his wife and children, son, mother, or sister on the issue of a battle, and when a dispute occurs, the owners decide the question by an appeal to the sword. In like manner Adrastus, the son of Midas, King of Phrygia, is said to have killed his brother in consequence of a quarrel which took place between them in regard to a battle of quails.

When Themistocles led the Greeks out against the Persians, happening to see two cocks fight, he shewed them as an example to his soldiers. Cock-fighting was afterwards exhibited annually in presence

* Ellis's Polynesian Researches, vol. i, p. 222.
† Crawfurd's Indian Archipelago, vol. i, p. 116.

of the whole people, and the crowing of a cock was ever after regarded as a presage of victory.*

The Javanese also fight hogs and rams together. The buffalo and tiger are matched against each other. In Butan the combat is between two bulls. Combats of elephants took place for the amusement of the early Indian kings. The Chinese and Javanese fight quails, crickets, and fish. The Romans fought cocks, quails, and partridges, also the rhinoceros. In Stamboul two rams are employed for fighting. The Russians fight geese, and the betting runs very high upon them.† We find horses, elephants, and oxen standing side by side with man in hostile array, and dogs were used by the Gauls for the same purpose. Amongst the ancients, the horse, the wolf, and the cock were offered on the altar of Mars for their warlike qualities.

Who can doubt with these examples before us, that an instinct so widely disseminated and so identical in men and animals, must have been ordained for special objects?

The causes which give rise to the exercise of the function, vary with the advance of civilization. We have now ceased to take delight in the mere exhibition of brute combats, but the profession of war is still held in as much esteem as at any previous period in the history of mankind, and we bestow the highest honours of the State upon successful combatants.

This however leads to another subject, viz., the causes of war amongst primitive races which is deserving of separate treatment.

Defensive Weapons.

We may pass briefly over the defensive weapons of animals and savages, not by any means from the analogy being less perfect in this class of weapons, but rather because the similarity is too obvious to make it necessary that much stress should be laid on their resemblance.

Hides.—The thick hides of pachydermatous animals, correspond to the quilted armour of ancient and semi-civilized races. Some animals like the rhinoceros and hippopotamus are entirely armed in this way, others have their defences on the most vulnerable part, as the mane of the lion, and the shoulder pad of the boar.‡ The skin of the tiger is of so tough and yielding a nature, as to resist the horn of the buffalo when driven with full force against its sides.§ The condor of Peru has such a thick coating of feathers, that eight or ten bullets may strike without piercing it.‖

According to Thucydides, the Locrians and Acarnanians, being professed thieves and robbers, were the first to clothe themselves in armour. But as a general rule it may be said, that the opinions of

* Beckman's History of Inventions—Cock-fighting.
† Stanley's History of Birds, p. 361.
‡ Darwin, Origin of Species, p. 88.
§ Williamson's Field Sports.
‖ Swainson's Habits and Instincts of Animals.

ancient writers upon the origin of the customs with which they were familiar, are of little value in our days. There is however evidence to show, that the use of defensive armour is not usual amongst savages in the lowest stages of culture. It is not employed, properly speaking, by the Australians, the Bushmen, the Fuegians, in the Fije or Sandwich Islands. But in many other parts of the world, soon after men began to clothe themselves in the skins of beasts, they appear to have used the thicker hides of animals for purposes of defence. When the Esquimaux apprehends hostility, he takes off his ordinary shirt, and puts on a deer's skin, tanned in such a manner as to render it thick for defence, and over this he again draws his ordinary shirt, which is also of deer-skin, but thinner in substance. The Esquimaux also use armour of eider drake's skin.* The Abipones and Indians of the Gran Chako, arm themselves with a cuirass, greaves, and helmet, composed of the thick hide of the tapir, but they no longer use it against the musketry of the Europeans. The Yucanas also use shields of the same material. The war dress of a Patagonian chief from the Museum of the Institution is exhibited (Plate XLIX, figs. 11, 12); it is composed of seven thicknesses of hide, probably of the horse, upon the body, and three on the sleeves. The chiefs of the Musgu negroes of Central Africa, use for defence a strong doublet of the same kind, made of buffalo's hide with the hair inside.† The Kyans of Borneo use hide for their war dress as shown by a specimen belonging to the Institution (Fig. 13). The skin of the bear and panther is most esteemed for this purpose.‡ The inhabitants of Pulo Nias, an island off the western coast of Sumatra, use for armour a baju made of leather.§ In some parts of Egypt a breast plate was made of the back of the crocodile (Fig. 14). In the island of Cayenne, in 1519, the inhabitants used a breast plate of buffalo's hide.‖ The Lesghi of Tartary wore armour of hog's skin.¶ The Indians of Chili, in the 17th century, wore corselets, back and breast-plates, gauntlets, and helmets of leather, so hardened, that it is decribed by Ovalle as being equal to metal.** According to Strabo, the German Rhoxolani wore collars, helmets, and shields of bull's hide, though the Germans generally, placed little reliance in defensive armour. The Ethiopians used the skins of cranes and ostriches for their armour.††

We learn from Herodotus that it was from the Lybians, the Greeks derived the apparel and ægis of Minerva, as represented upon her images, but instead of a pectoral of scale armour, that of the Lybians was merely of skin.‡‡ According to Smith's dictionary of Greek and

* Beechey's Voyage to the Pacific, vol. i, p. 248.
† Barth, vol. iii.
‡ Sarawak, by Hugh Low, Esq., Colonial Secretary at Labuan, 1848.
§ Dobrizhoffer.
‖ Pigafetta's Voyage Round the World. Pinkerton, vol. ix, p. 349.
¶ Travels of William de Rubruquis into Tartary and China in 1253; Pinkerton, vol. viii, p. 89.
** An Historical relation of the Kingdom of Chile, by Alonso de Ovalle, of the Company of Jesus, 1649.
†† Herodotus; Meyrick's Ancient Armour.
‡‡ Meyrick's Ancient Armour, vol. i, pl. iv.

Roman Antiquities, the Greek thorax, called *σταδιος*, from its standing erect by its own stiffness, was originally of leather, before it was constructed of metal. In Meyrick's Ancient Armour, there is the figure of a suit, supposed formerly to have belonged to the Rajah of Guzerat (Plate L, fig. 15). The body part of this suit is composed of four pieces of rhinoceros hide, showing that, in all probability, this was the material originally employed for that particular class of armour, which is now produced of the same form in metal, a specimen of which, from the Museum of the Institution, taken from the Sikhs, is now exhibited (Fig. 16).

In more advanced communities, as skins began to be replaced by woven materials, quilted armour supplied the place of hides. In those parts of the Polynesian Islands, in which armour is used, owing probably to the absence of suitable skins, woven armour appears to have been employed in a comparatively low state of society. Specimens of this class of armour from the Museum of the Institution are exhibited; they are from the King's Mill, Pleasant Island, and the Sandwich Islands. A helmet from the latter place (Fig. 17) much resembles the Grecian in form, while the under tippet, from Pleasant Island (Plate XLIX, fig. 18), may be compared to the pectoral of the Egyptians (Fig. 19, *a* and *b*), which, as well as the head dress (Plate L, fig. 20), was of a thickly quilted material. The Egyptians wore this pectoral up to the time of Xerxes, who employed their sailors, armed in this way, during his expedition into Greece. Herodotus says that the Indians of Asia wore a thorax of rush matting. In 1514, Magellan* found tunics of quilted cotton, called laudes, in use by the Muslims of Guzerat and the Deccan. An Indian helmet of this description from my collection (Fig. 21) is exhibited; in form it resembles the Egyptian, and an Ethiopian one (Fig. 22), composed of beads of the same form, brought from Central Africa by Consul Petherick is exhibited. Fig. 23 shows that the same form, in India, was subsequently produced in metal. A suit of quilted armour formerly belonging to Koer Singh, and lately presented to the Institution by Sir Vincent Eyre is also exhibited (Plate XLIX, fig. 24). The body armour and helmet found upon Tippoo Saib at his death, and which is now in the Museum of the Institution (Plate LI, fig. 25, *a*, *b*, and *c*), was thickly quilted. Upon the breast, this armour consists of two sheets of parchment, and nine thicknesses of padding composed of cocoons of the Saturnia mylitta, stuffed with the wool of the Eriodendron anfractuosum, D. C., neatly sewn together, as represented in Fig. 25 *b*.† The Aztecs and Peruvians also guarded themselves with

* The Coasts of East Africa and Malabar, by Duarte Barbosa, translated from the Spanish, by the Hon. H. E. Stanley, for the Hakluyt Society. Since publication, the translator has ascertained that the authorship of this work should be ascribed to Magellan.

† The Saturnia mylitta is the caterpillar from which the Tusseh-silk is obtained, the cocoon is of an oval shape when suspended upon the tree, and of exceedingly firm texture; it is figured in Sir Wm. Jardine's Naturalist's Library, vol. xxxii. The Eriodendron anfractuosum, D. C., is an Indian Bombax. The woolly cotton which envelopes the seed is remarkable for its softness, and is much and deservedly esteemed for making cushions and bedding, owing to its freedom from any tendency to become lumpy and uneven by getting impacted into hard knots. Various

a wadded cotton doublet.* Quilted armour or thick linen corselets were used by the Persians, Phœnicians, Chalibes, Assyrians, Lusitanians, and Scythians, by the Greeks, and occasionally by the Romans. By the Persians it was used much later; and in Africa to this day, quilted armour, of precisely the same description, is used both for men and horses by the Bornouese of Central Africa, and is described by Denham and Clapperton (Plate L, fig. 26). Plate XLIX, fig. 27 is a suit of armour in the Institution, from the Navigator's Islands, composed of cocoa-nut fibre coarsely netted. Fig. 28 is part of a Chinese jacket of sky-blue cotton, quilted with enclosed plates of iron, it is precisely similar to the Brigandine jacket used in Europe in the 16th century, which was composed of "small plates of iron quilted within some stuff, and "covered generally with sky-blue cloth."† This class of armour may be regarded as a link connecting the quilted, with the scale armour, to be described hereafter.

As a material for shields, the hides of animals were employed even more universally, and up to a later stage of civilization. In North America, the majority of the wild tribes use shields of the thickest parts of the hides of the buffalo.‡ In the New Hebrides, the skin of the alligator is used for this purpose, as appears by a specimen belonging to the Institution. In Africa, the Fans of the Gaboon employ the hide of the elephant for their large rectangular shields.§ The Wadi, the Wagogo, and the Abyssinians in East Africa, have shields of buffalo's hide, or some kind of leather, like the Ethiopians of the time of Herodotus. The ox-hide shields of the Greeks are mentioned in Homer's Iliad; that of Ajax was composed of seven hides with a coating of brass on the outside. The spear of Hector is described as piercing six of the hides and the brass coating, remaining fixed in the seventh hide.‖ The Caffres, Bechuanas, Bassutos, and others in South Africa, use the hide of the ox.¶ The Kelgeres, Kelowi, and Tawarek, of Central Africa, employ the hide of the Leucoryx antelope.** Shields of the rhinoceros hide, from Nubia, and of the ox, from Fernando Po, are exhibited. In Asia, the Biluchi carry shields of the rhinoceros horn, and the same material is also used in East Africa.†† A specimen from Zanzibar is in the Institution. In the greater part of India, the shields are made of rhinoceros and buffalo's

attempts have been made to fabricate it into cloth, but hitherto without success, except as a very loose material, fit only for quilting muffs, for which it is superior to cotton or woollen stuffs, the looseness of its texture rendering it an excellent non-conductor, whilst at the same time it is extremely light.—Illustrations of Indian Botany, by Robert Wight, M.D., F.L.S., vol. 1, p. 68.—Flora Indica.—Roxburgh, vol. iii, p. 169. Both the caterpillar and the plant are found in the jungle in the neighbourhood of Seringapatam. For the identification of the vegetable substance, I am indebted to W. Carruthers, Esq., F.L.S., British Museum.

* Schoolcraft.—Meyrick.

† See Critical Enquiry into Ancient Armour, by Sir Samuel R. Meyrick, vol. iii, p. 21, and pl. lxviii.

‡ Bollaert, Indians of Texas, Trans. Ethno. Soc., vol. 1–2.

§ Du Chaillu, p. 79, 80.

‖ Iliad, vii.

¶ Cassalis.

** Barth, vol. i.

†† Meyrick, pl. cxlvii.

hide, boiled in oil, until they sometimes become transparent, and are proof against the edge of a sabre.*

In a higher state of civilization, as the facilities for constructing shields of improved materials increased, the skins of animals were still used to cover the outside. Thus the negroes of the Gold Coast made their shields of osier covered with leather.† That of the Kanembu of Central Africa is of wood covered with leather,‡ and very much resembles in form that of the Egyptians, which, as we learn from Meyrick and others, was also covered with leather, having the hair on the outside like the shields of the Greeks.§ The Roman scutum was of wood covered with linen and sheepskin. According to the author of "Horæ Ferales," the Saxon shield was of wood covered with leather; the same applies to the Scotch target, and leather was used as a covering for shields, as late as the time of Henry VIII.

Head Crests.—The origin of the hairy crests of our helmets, is clearly traceable to the custom of wearing for head-dresses the heads and hair of animals. The Asiatic Ethiopians used as a head-covering, the skin of a horse's head, stripped from the carcase together with the ears and mane, and so contrived, that the mane served for a crest, while the ears appeared erect upon the head. In the coins representing Hercules, he appears wearing a lion's skin upon the head. These skins were worn in such a manner that the teeth appeared grinning at the enemy over the head of the wearer, as represented in Plate L, fig. 29, which is taken from a bronze in the Blacas collection, a custom which seems also to have prevailed in Mexico.‖ Similar head-dresses are worn by the soldiers on Trajan's column. The horns worn on the heads of some of the North American Indians (Fig. 30), and in some parts of Africa,¶ are no doubt derived from this practice of wearing on the head, the skins of animals with their appendages. The helmet of Pyrrhus, King of Epirus, was surmounted by two goat's horns. Horns were afterwards represented in brass, on the helmets of the Thracians (Fig. 31), the Belgic Gauls, and others. Fig. 32 is an ancient British helmet of bronze lately found in the Thames, surmounted by straight horns of the same material.** Horned helmets are figured on the ancient vases. Fig. 33 is a Greek helmet having horns of brass, and traces of the same custom may still be observed in heraldry.††

The practice of wearing head-dresses of feathers, to distinguish the chiefs from the rank and file, is universal in all parts of the world, and in nearly every stage of civilization. Amongst the North American Indians, the feathers are cut in a particular manner to denote the rank of the wearer, precisely in the same manner that the long feathers of

* Meyrick's Engraved Illustrations of Ancient Armour, by J. Skelton, F.S.A., vol. ii, pl. exli.

† Bosman's Guinea, Pinkerton, vol. xii, p. 413.

‡ Barth, Denham and Clapperton.

§ Meyrick, vol. i, p. 111. ‖ Meyrick, vol. i, p. 20.

¶ At Fernando Po.—Cumming on Weapons and Armour of Horn, Journal of the Archæological Association, vol. iii.

** Fig. 32 is from a rough sketch taken about two years ago, and has no pretension to accuracy of detail.

†† Meyrick, vol. i, pl. iv.

our general officers distinguish them from those wearing shorter feathers in subordinate ranks. This custom, Mr. Schoolcraft observes, when describing the head-dresses of the American Indians, may very probably be derived from the feathered creation, in which the males, in most of the cock, turkey, and pheasant tribes, are crowned with bright crests and ornaments of feathers.

Solid Plates.—It has often struck me as remarkable that the shells of the tortoise and turtle, which are so widely distributed and so easily captured, and which would appear to furnish shields ready made to the hand of man, should seldom, if ever, in so far as I have been able to learn, be used by savages for that purpose. This may, however, be accounted for by the fact that *broad* shields of that particular form, though common in more advanced civilizations, are never found in the hands of savages, at least in those localities in which the turtle, or large tortoise, is available.

It will be seen subsequently, in tracing the history of the shield, that in the rudest condition of savage life, this weapon of defence has a history of its own; that both in Africa and Australia, it is derived by successive stages from the stick or club, and the broad shield does not appear to have been developed until after mankind had acquired sufficient constructive skill to have been able to form shields of lighter and more suitable materials than is afforded by the shell of the turtle. It is, however, evident that in later times, the analogy was not lost sight of, as the word testudo is a name given by the Romans to several engines of war having shields attached to them, and especially to that particular formation of the legionary troops, in which they approached a fortified building with their shields joined together, and overlapping, like the scaly shell of the imbricated turtle, which is a native of the Mediterranean and Asiatic seas.

Jointed Plates.—In speaking of the jointed plates, so common to all the crustacea, it is sufficient to notice that this class of defence in the animal kingdom, may be regarded as the prototype of that peculiar form of armour which was used by the Romans, and to which the French, at the commencement of the 17th century, gave the name of "écrevisses," from its resemblance to the shell of a lobster. The fluted armour, common in Persia, and, in the middle ages, of Europe, is also constructed in exact imitation of the corrugated shell defences of a large class of the Mollusca.

Scale armour.—That scale armour derived its origin from the scales of animals, there can be little doubt. It has been stated on the authority of Arrian, that the Greeks distinguished scale armour by the term λεπιδωτός, expressive of its resemblance to the scales of fish whilst the jointed armour, composed of long flexible bands, like the armour of the Roman soldier, and the écrevisses of the middle ages was called φολιδωτός from its resemblance to the scales of serpents. The brute origin of scale armour is well illustrated by the breast plate of the Bugo Dyaks, a specimen of which, from the Museum of the Institution, is exhibited (Plate LI, fig. 34). The process of its construction was described in a notice attached to a specimen of this armour in the Exhibition of 1862. The scales of the Pangolin are collected by the Bugis

as they are thrown off by the animal, and are stitched on to bark with small threads of cane, so as to overlap each other in the same manner that they are arranged on the skin of the animal. When the front piece is completely covered with scales, a hole is cut in the bark for the head of the wearer. The specimen now exhibited appears, however, to be composed of the entire skin of the animal. Captain Grant, in his "Walk across Africa," mentions that the scales of the armadillo are in like manner collected by the negroes of East Africa, and worn in a belt "three inches across," as a charm.*

It is reasonable to suppose that the use of scale armour, in most countries, originated in this manner by sewing on to the quilted armour before described, fragments of any hard material calculated to give it additional strength. Plate L, fig. 35 is a piece of bark from Tahiti, studded with pieces of cocoa-nut stitched on. The Sarmatians and Quadi are described by Ammianus Marcellinus as being protected by a lorica, composed of pieces of horn, planed and polished, and fastened like feathers upon a linen shirt.† Pausanias also, who is confirmed by Tacitus, says that the Sarmatians had large herds of horses, that they collected the hoofs, and after preparing them for the purpose, sewed them together, with the nerves and sinews of the same animal, so as to overlap each other like the surface of a fir cone, and he adds, that the lorica thus formed was not inferior to that of the Greeks either in strength or elegance. The Emperor Domitian had, after this model, a cuirass of boar's hoofs stitched together.‡ Fig. 36 represents a fragment of scale armour made of horn found at Pompeii. A very similar piece of armour (Fig. 37), from some part of Asia, said to be from Japan, but the actual locality of which is not known, is figured in Meyrick's Ancient Armour, Pl. L. It is made of the hoofs of some animal, stitched and fastened so as to hold together without the aid of a linen corselet. An ancient stone figure§ (Plate LI, fig. 38), having an inscription in a character cognate to the Greek, but in an unknown language, and covered with armour of this description, is represented in the third volume of the Journal of the Archæological Association. The Kians inhabiting the eastern coast of Borneo, form a kind of armour composed of little shells placed one overlapping the other, like scales, and having a large mother-of-pearl shell at the end. This last portion of the armour is shown in the figure of the Kian war-dress already referred to (Fig. 13). Plate L, fig. 39 is a back- and breast-piece of armour from the Sandwich Islands, composed of seals' teeth, set like scales, and united with string.

Similar scales would afterwards be constructed in bronze and iron. It was thus employed by the Egyptians (Plate LI, fig. 40), two scales of which are shown in Fig. 41; also by the Persians, Assyrians, Philistines, Dacians, and most ancient nations.

The armour of Goliah is believed to have been of scales, from the fact of the word "kaskassim," used in the text of 1 Samuel, xvii,

* Walk across Africa, p. 47.
† Smith's Dictionary—Meyrick's Ancient Armour, pl. iii.
‡ Pictorial Bible, note to 1 Samuel, chap. xvii.
§ Cumming—Journal of the Archæological Association, vol. iii.

being the same employed in Leviticus and Ezekiel, to express the scales of fish.* Amongst the Romans, scale armour was regarded as characteristic of barbarians, but they appear to have adopted it in the time of the Emperors. A suit of Japanese armour in my collection shows four distinct systems of defence, the back and breast being of solid plates, the sleeves and leggings composed of small pieces of iron, stitched on to cloth, and united with chain, whilst other portions are quilted with enclosed pieces of iron (Fig. 42, *a* and *b*). Fig. 43, *a* and *b*, is a suit of Chinese armour, in the Museum, having large iron scales on the inside (Fig. 44). This system was also employed in Europe. Fig. 45 is the inner side of a suit of Jazerine armour of the 15th or 16th century, in my collection. Fig. 46 represents a similar suit in the Museum of the Institution, probably of the same date, having large scales of iron on the outside. A last vestige of scale armour may be seen in the dress of the Albanians which, like the Scotch and ancient Irish kilt, and that formerly worn by the Maltese peasantry, is a relic of costume of the Greek and Roman age. In the Albanian jacket the scales are still represented in gold embroidery.†

Offensive Weapons of Men and Animals.

Piercing Weapons.—The Gnu of South Africa, when pressed, will attack men, bending its head downwards, so as to pierce with the point of its horn.‡ The same applies to many of the antelope tribe. The rhinoceros destroys the elephant with the thrust of its horn, ripping up the belly (Plate LII, fig. 47). The horn rests on a strong arch formed by the nasal bones; those of the African rhinoceros, two in number, are fixed to the nose by a strong apparatus of muscles and tendons, so that they are loose when the animal is in a quiescent state, but become firm and immovable when he is enraged, showing in an especial manner that this apparatus is destined for warlike purposes.§ It is capable of piercing the ribs of a horse, passing through saddle, padding, and all.‖ Mr. Atkinson, in his Siberian Travels, speaks of the tusk of the wild boar, which in those parts is long, and as sharp as a knife, and he describes the death of a horse which was killed by a single stroke from this animal, delivered in the chest.¶ The buffalo charges at full speed with its horns down.** The bittern, with its beak, aims always at the eye.†† The walrus (Fig. 48) attacks fiercely with its

* Pictorial Bible, note to 1 Samuel xvii.
† Skene on the Albanians, vol. i–ii—Ethnological Journal.
‡ Cassalis, Account of the Bassutos, p. 172.
§ Maunder's Treasury of Natural History.
‖ Williamson's Field Sports, vol. i, p. 174.
¶ Atkinson's Travels in Siberia, p. 425.
** Williamson's Field Sports.
†† Thompson's Passions of Animals, p. 225. The American hunter avails himself of this pecularity to entrap the crane by presenting the barrel of his firelock to the animal; supposing it to be an eye, the crane immediately strikes at the hole, and fixes its beak firmly in the muzzle.

pointed tusks, and will attempt to pierce the side of a boat with them.* The needle fish of the Amazons is armed with a long pointed lance.† The same applies to the sword-fish of the Mediterranean and Atlantic (Fig. 49), which, notwithstanding its food is mostly vegetable, attacks the whale with its spear point on all occasions of meeting. There is an instance on record of a man, whilst bathing in the Severn near Worcester, having been killed by the sword-fish.

The weapon of the sword-fish is used as a spear-head by the wild tribes of Cambodia, and some idea may be formed of its efficiency for this purpose, and of the confidence with which it is used, by the following account of an attack on a rhinoceros with this weapon, by Mons. Mouhot.‡ He says:—

"The manner in which the rhinoceros is hunted by the Laotians is "curious, on account of its simplicity and the skill they display. They "had bamboos, with iron blades, something between a bayonet and a "poignard. The weapon of the chief was the horn of a sword-fish, "long, sharp, strong, supple, and not likely to break. Thus armed, "we set off into the thickest part of the forest, with all the windings "of which our leader was familiar, and could tell with tolerable cer-"tainty where we should find our expected prey. After penetrating "nearly two miles into the forest, we suddenly heard the crackling of "branches, and rustling of the dry leaves. The chief went on in "advance, signing to us to keep a little way behind, but to have our "arms in readiness. Soon our leader uttered a shrill cry, as a token "that the animal was near. He then commenced striking against "each other two bamboo canes, and the men set up wild yells to pro-"voke the animal to quit his retreat.

"A few minutes only elapsed before he rushed towards us, furious "at having been disturbed. He was a rhinoceros of the largest size, "and opened a most enormous mouth. Without any sign of fear, but "on the contrary of great exultation, as if sure of his prey, the "intrepid hunter advanced, lance in hand, and then stood still waiting "for the creature's assault. I must say I trembled for him, and loaded "my gun with two balls; but when the rhinoceros came within reach, "and opened his immense jaws to seize his enemy,§ the hunter thrust "his lance into him to a depth of some feet, and calmly retired to "where we were posted." After the animal was dead, the chief withdrew his sword-fish blade, and presented it to Mons. Mouhot.

The narwhal has a still more formidable weapon of the same kind (Fig. 50). It attacks the whale, and occasionally the bottoms of ships a specimen of the effect of which attack, from the Museum of the Institution, is now exhibited (Fig. 51). The Esquimaux, who, in the accounts of which they give of their own customs, profess to derive much experience from the habits of the animals amongst which they live, use the narwhal's tusk for the points of their spears. Fig. 52

* Beechey's Voyage to the North Pole, pp. 91, 94.

† Bates—Naturalist on the Amazons, vol. ii, 141.

‡ Travels in the central parts of Indo-China, Siam, Cambodia, and Laos, in 1858–9, by the late M. Henri Mouhot, vol. ii, p. 147.

§ It is to be observed that this is not the rhinoceros's usual mode of attack.

represents a nuguit from Greenland, of the form mentioned by Crantz; it is armed with the point of the narwhal's tusk. Fig. 53, from my collection, has the shaft also of narwhal's tusk; it is armed with a metal blade, but it is introduced here in order to show the association which existed in the mind of the constructor between his weapon and the animal from which the shaft is derived, and for the capture of which it is chiefly used. The wooden shaft, it will be seen, is constructed in the form of the fish, and the ivory fore shaft is inserted in the snout in the exact position of that of the fish itself. At Kotzebue Sound Captain Beechey* found the natives armed with lances composed of a walrus tooth fixed to the end of a wooden staff (Fig. 54). They also employ the walrus tooth for the points of their tomahawks (Fig. 55). The horns of the antelope are used as lance points by the Djibba negroes of Central Africa, as already mentioned, and in Nubia also by the Shillooks and Dinka.† The antelope's horn is also used in South Africa for the same purpose.‡ The argus pheasant of India,§ the wing-wader of Australia,‖ and the plover of Central Africa,¶ have spurs on their wings, with which they fight; the cock and turkey have spurs on their feet, used expressly for offence. The white crane of America has been known to drive its beak deep into the bowels of a hunter.** The Indians of Virginia, in 1606, are described as having arrows armed with the spurs of the Turkey, and beaks of birds††. In the Christy collection there is an arrow supposed to be from South America, which is armed with the natural point of the deer's horn (Fig. 56). The war club of the Iroquois, called GA-NE-U-GA-O-DUS-HA, or "deer-horn war club," was armed with a point of the deer's horn (Fig. 57), about 4 inches in length; since communication with Europeans, a metal point has been substituted (Fig. 58). It appears highly probable that the martel-de-fer of the 15th and 16th centuries, and which is also used in India and Persia, may have been derived, as its form indicates, from a horn weapon of this kind. Horn points suitable for arming such weapons have been found both in England and Ireland, two specimens of which are in my collection.‡‡ The weapon of the sting ray, from the method of using it by the animal itself, should more properly be classed with serrated weapons, but it is a weapon in general use amongst savages for spear or arrow points (Fig. 59), for which it has the particular merit of breaking off in the wound. It causes a frightful wound, and being sharply serrated, as well as pointed, there is no means of cutting it out. It is used in this way

* Beechey's Voyage, p. 252.
† Journal of the Archæological Association, vol. iii, p. 25.
‡ Ibid. vol. iii, p. 26.
§ Swainson's Habits and Instincts of Animals, p. 141.
‖ Gregory's Expedition to the North-west Coast of Australia, vol. 32—Royal Geographical Society's Journal.
¶ Denham and Clapperton's Travels, p. 20.
** Narrative of the Canadian Exploring Expedition, by G. H. Hind, p. 316.
†† Captain John Smith's Sixth Voyage to Virginia in 1606; Pinkerton, vol. xiii, p. 36.
‡‡ See Cuming on Weapons of Horn, Journal of the British Archæological Association, vol. iii, p. 27.

by the inhabitants of Gambier Island, Samoa,* Otaheite,† the Fije Islands,‡ Pellew Islands,§ and many of the low islands. Amongst the savages of tropical South America, the blade of the ray, probably the trygon histrix, is used for arrow points.‖

In the "Balistes capriscus" (Fig. 60*a*) a rare British fish, the anterior dorsal, is preceded by a strong erectile spine, which is used for piercing other fishes from beneath. Its base is expanded and perforated, and a bolt from the supporting plate passes freely through it. When this spine is raised, a hollow at the back receives a prominence from the next bony ray, which fixes the spine in an erect position, as the hammer of a gun-lock acts at full cock, and the spine cannot be forced down till this prominence is withdrawn, as by pulling the trigger, "This "mechanism may be compared to the fixing and unfixing of a "bayonet; when the spine is unfixed and bent down, it is received "into a groove on the supporting plate, and offers no impediment to "the progress of the fish through the water." These fishes are also found in a fossil state, and to use the words of Professor Owen, from whose work this description of the Balistes is borrowed: "exemplify "in a remarkable manner the efficacy, beauty, and variety of the ancient "armoury of that order."¶ The stickleback is armed in a similar manner, and is exceedingly pugnacious. The Cottus diceraus, Pall., (Fig. 60*b*) has a multi-barbed horn on its back, exactly resembling the spears of the Esquimaux, South American, and Australian savages. The Naseus fronticornis, Lac., (Fig. 60*c*) has also a spear-formed weapon. The Yellow-bellied acanthurus is armed with a spine of considerable length upon its tail.

The Australians of King George's Sound used the pointed fin of the roach to arm their spears,** the inhabitants of New Guinea also arm their arrows with the offensive horn of the saw-fish, and with the claw of the cassowary. The sword of the limulus, or king-crab, is an offensive weapon; its habits do not appear to be well understood, but its weapon is used in some of the Malay islands for arrow points (Fig. 61). The natives of San Salvador, when discovered by Columbus, used lances pointed with the teeth of fish.†† The spine of the Diodon is also used for arrow points (Fig. 62). Amongst other piercing weapons suggested by the horns of animals, may be noticed, the Indian kandjar composed of one side of the horn of the buffalo, having the natural form and point (Fig. 63). In later times a metal dagger, with ivory handle was constructed in the same country (Fig. 64), after the exact model of the one of horn, the handle having one side flat, in imitation of the half-split horn, though of course that peculiar form was no longer necessitated by the material then used. The same form of weapon was afterwards used with a metal handle (Fig 65).

* Nineteen Years in Polynesia, Turner, p. 276.
† Beechey's Voyage to the Pacific, vol. i, ch. vi.
‡ Fije and the Fijeans, by T. Williams, Missionary, vol. i, ch. iii.
§ Wilson's Pellew Islands, Keate, pl. v.
‖ Klemm Wertzenge und Waffen, p. 48.
¶ Comparative Anatomy and Physiology of Vertebrates, Owen, vol. i, p. 193.
** Klemm, p. 31 †† Pre-historic Man, vol. i, p. 145.

The sharp horns of the sasin, or common antelope, often steel pointed, are still used as offensive weapons in India (Figs. 66, 67, 68). Several examples of these are in the Museum of the Institution. Three stages of this weapon are exhibited, the first having the natural point, the second a metal point, and the third a weapon of nearly the same form composed entirely of metal. The Fakirs and Dervish's, not being permitted by their profession to carry arms, use the pointed horn of the antelope for this purpose. Fig. 69 is a specimen from my collection; from its resemblance to the Dervish's crutch of Western Asia, I presume it can be none other than the one referred to in the Journal of the Archæological Association, from which I obtained this information respecting the Dervish's weapon.* Mankind would also early derive instruction from the sharp thorns of trees, with which he must come in contact in his rambles through the forests, the African mimosa, the gledischia, the American aloe, and the spines of certain palms, would afford him practical experience of their efficacy as piercing weapons, and accordingly we find them often used by savages in barbing their arrows.†

Striking Weapons.—Many animals defend themselves by blows delivered with their wings or legs; the giraffe kicks like a horse as well as strikes side-ways with its blunt horns; the camel strikes with its fore legs and kicks with its hind legs; the elephant strikes with its proboscis and tramples with its feet; eagles, swans, and other birds strike with their wings; the swan, is said to do so, with sufficient force to break a man's leg; the cassowary strikes forward with its feet; the tiger strikes a fatal blow with its paw; the whale strikes with its tail, and rams with such force that the American whaler "Essex," is said to have been sunk by that animal.‡ There is no known example of mankind in so low a state as to be unacquainted with the use of artificial weapons. The practice of boxing with the fist, however, is by no means confined to the British Isles as some people seem to suppose, for besides the Romans, Lusitanians,§ and others mentioned in classical history, it prevailed certainly in the Polynesian islands‖ and in Central Africa.¶

Serrated Weapons.—This class of weapons in animals corresponds to the cutting weapons of men. Amongst the most barbarous races, however, as amongst animals, no example of a cutting weapon is found,**

* Journal of the Archæological Association, vol. iii, p. 26—Cuming on Weapons of Horn.

† The probability of the aboriginal man having derived his first lessons from this source may be judged of by the accounts given by travellers of the effects produced by the large thorns of trees in South Africa, of which there is a good account in Routledge's Natural History of Man, by the Rev. J. G. Wood, chap. xxi, Kaffir. Large animals are said to be frequently destroyed, and even to have impaled themselves upon the large, strong spines of the thorny Acacia. Throughout Central Africa a pair of tweezers for extracting thorns is an indispensable requisite in the equipment of every native.

‡ Beechey's Voyage to the Pacific, vol. i, p. 47.

§ Strabo, b. iii, c. iii. ‖ Ellis's Polynesian Researches, chap. viii.

¶ Clapperton's Travels, p. 58.

** I exclude from this category all nippers, cross bills, and prehensile implements.

although the Polynesian islanders make very good knives of the split and sharpened edges of bamboo, and the Esquimaux, also, use the split tusk of the walrus as a knife, they cannot be regarded, nor, indeed, are they used, as edged weapons. These, strictly speaking, are confined to the metal age, and their place, in the earliest stages of civilization, are supplied by weapons with serrated, or saw-like edges.

Perhaps the nearest approach in the animal kingdom to an edged weapon is the fore-arm of the mantis, a kind of cricket, used by the Chinese and others in the East for their amusement. Their combats have been compared to that of two soldiers fighting with sabres. They cut and parry with their fore-arms, and, sometimes, a single stroke with these is sufficient to decapitate or cut in two, the body of an antagonist. But, on closer inspection, these fore-arms are found to be set with a row of strong and sharp spines, similar to those of all other animals that are provided with this class of weapon. The snout of the saw-fish is another example of the serrated weapon. Its mode of attacking the whale is by jumping up high in the air, and falling on the animal, not with the point, but with the sides of its formidable weapon, both edges of which are armed with a row of sharp horns, set like teeth, by means of which it rasps a severe cut in the flesh of the whale. The design in this case is precisely analogous to that of the Australian savage, who throws his similarly constructed spear so as to strike, not with the bone point, but with its more formidable edges, which are thick set with a row of sharp-pointed pieces of obsidian, or rock-crystal. The saw-fish is amongst the most widely distributed of fishes, belonging to the arctic, antarctic, and tropical seas. It may, therefore, very possibly have served as a model in many of the numerous localities in which this character of weapon is found in the hands of savages. The snout itself is used as a weapon by the inhabitants of New Guinea, the base being cut and bound round so as to form a handle. Plate LIII, fig. 70, is a specimen from the Museum of the Institution. The weapon of the sting ray, though used by savages for spear-points, more properly belongs to this class, as the mode of its employment by the animal itself consists in twisting its long, slender tail round the object of attack, and cutting the surface with its serrated edge.* The teeth of all animals, including those of man himself, also furnish examples of serrated weapons.

When we find models of this class of weapon so widely distributed in the lower creation, it is not surprising that the first efforts of mankind in the construction of trenchant implements, should so universally consist of teeth or flint flakes, arranged along the edges of staves or clubs, in exact imitation of the examples which he finds ready to his hand, in the mouths of the animals which he captures, and on which he is dependent for his food. Several specimens of implements, edged in this manner with sharks' teeth, from the Museum of the Institution, are now exhibited (Figs. 71, 72, 73, 74). They are found chiefly in the Marquesas, in Tahite, Depeyster's Island, Byron's Isles, the King's Mill group, Radack Island†, and the Sandwich Islands‡, also in New

* Naturalist's Library, vol. iii, p. 335.

† Voyage Pictoresque Autour du Monde, par M. Louis Choris, peintre 1822.

‡ Cook's Third Voyage.

Zealand (Fig. 75). They are of various shapes, and used for various cutting purposes, as knives, swords, and glaves. Two distinct methods of fastening the teeth to the wood prevail in the Polynesian Islands; firstly, by inserting them in a groove cut in the sides of the stick or weapon, and, secondly, by arranging the teeth in a row, along the sides of the stick, between two small strips of wood on either side of the teeth, lashed on to the staff, in all cases, with small strings, composed of plant fibre. The points of the teeth are usually arranged in two opposite directions on the same staff, so that a severe cut may be given either in thrusting or withdrawing the weapon.*

A similarly constructed implement, also edged with sharks' teeth, was found by Captain Graah, on the east coast of Greenland, and is mentioned in Dr. King's paper on the industrial arts of the Esquimaux, in the Transactions of the Ethnological Society.† The teeth in this implement were secured by small nails, or pegs of bone; it was also used formerly on the West Coast. A precisely similar implement (Fig. 76), but showing an advance in art by being set with a row of chips of meteoric iron, was found amongst the Esquimaux of Davis Strait, and is now in the department of meteorolites in the British Museum. Others, of the same nature, from Greenland, are in the Christy collection (Fig. 77). The pacho, of the South Sea Islands, appears to have been a sort of club, armed on the inner side with shark's teeth, set in the same manner.‡ The Tapoyers, of Brazil, used a kind of club, which was broad at the end, and set with teeth and bones, sharpened at the point.§

Hernandez gives an account of the construction of the Mexican Maquahuilt or Aztec war club, which was armed on both sides with a row of obsidian flakes, stuck into holes, and fastened with a kind of gum‖ (Fig. 78). Herrera, the Spanish historian, also mentions these as swords of wood, having a groove in the fore part, in which the flints were strongly fixed with bitumen and thread.¶ In 1530, according to the Spanish historians, Copan was defended by 30,000 men, armed with these weapons, amongst others;** and similar weapons have been represented in the sculptures of Yucatan.†† They are also represented in Lord Kingsborough's important work on Mexican Antiquities, from which the accompanying representations are taken (Figs. 78, 79, 80). One of these swords, having six pieces of obsidian on each side of the blade, is to be seen in a Museum in Mexico.

In the burial mounds of Western North America, Mr. Lewis Morgan, the historian of the Iroquois, mentions that rows of flint flakes have been found lying, side by side, in order, and suggesting the idea

* Klemm, ; Wilkes's United States Exploring Expedition, vol. v, ch. ii.

† Trans. Ethnol. Soc., vols. i–ii, p. 290.

‡ Ellis's Polynesian Researches, chaps. xi, xii.

§ Menhoff—Travels in Brazil; Pinkerton, vol. xiv, p. 874.

‖ Tylor—Anahuac, Appendix.

¶ Pre-historic Man, vol. i, p. 216, 217.

** Incidents of Travel in Central America, by J. Lloyd Stephens, p. 51.

†† Pre-historic Man, vol. i, p. 226, 227.

that they must have been fastened into sticks in the same manner as those of Mexico and Yucatan.

Throughout the entire continent of Australia the natives arm their spears with small sharp pieces of obsidian, or crystal, and recently of glass, arranged in rows along the sides near the point, and fastened with a cement of their own preparation, thereby producing a weapon which, though thinner in the shaft, is precisely similar in character to those already described (Figs. 81 and 82). Turning again to the northern hemisphere, we find in the Museum of Professor Nilsson, at Lund, in Sweden, a smooth, sharp-pointed piece of bone, found in that country, about six inches long, grooved on each side to the depth of about a quarter of an inch, into each of which grooves a row of fine, sharp-edged, and slightly-curved flints were inserted, and fixed with cement. The instrument thus armed was fastened to the end of a shaft of wood, and might either have been thrown by the hand or projected from a bow (Fig. 83). Another precisely similar implement (Fig. 84) is represented in the illustrated catalogue of the Museum at Copenhagen, showing that in both these countries this system of constructing trenchant implements was employed. In Ireland, although there is no actual evidence of flints having been set in this manner, yet from the numerous examples of this class of weapon that are found elsewhere, and the frequent occurrence of flint implements of a form that would well adapt them to such a purpose, the author of the Catalogue of the Royal Irish Academy expresses his opinion that the same arrangement may very possibly have existed in that country, and that the wood in which they were inserted may, like that which, as I have already said, is supposed to have held the flints found in the graves of the Iroquois, have perished by decay.

Poisoned Weapons.—It is unnecessary to enter here into a detailed account of the use of poison by man and animals. Its use by man as a weapon of offence is chiefly confined to those tropical regions in which poisonous herbs and reptiles are most abundant. It is used by the Negroes, Bushmen, and Hottentots of Africa; in the Indian Archipelago, New Hebrides, and New Caledonia. It appears formerly to have been used in the South Seas. It is employed in Bootan, Assam, by the Stiens of Cambodia, and formerly by the Moors of Mogadore. The Parthians and Scythians used it in ancient times; and it appears always to have been regarded by ancient writers as the especial attribute of barbarism. The Italian bravoes of modern Europe also used it. In America it is employed by the Darian Indians in Guiana, Brazil, Peru, Paraguay, and on the Orinoco. The composition of the poison varies in the different races, the Bushmen and Hottentots using the venomous secretions of serpents and caterpillars,* whilst most other nations of the world employ the poisonous herbs of the different countries they locate, showing that in all probability this must have been one of those arts which, though of very early origin, arose spontaneously and separately in the various quarters of the globe, after the human family had separated. This subject, however,

* Thernberg's Account of the Cape of Good Hope—Livingstone.

is deserving of a separate treatment, and will be alluded to elsewhere.

In drawing a parallel between the weapons of men and animals used in the application of poison for offensive purposes, two points of similitude deserve attention.

Firstly. The poison gland of many serpents is situated on the upper jaw, behind and below the eyes. A long excretory duct extends from this gland to the outer surface of the upper jaw, and opens above and before the poison teeth, by which means the poison flows along the sheath into the upper opening of the tooth in such a manner as to secure its insertion into the wound. The hollow interior of the bones with which the South American and other Indians arm their poisoned arrows secures the same object (Fig. 85); it contains the poisonous liquid, and provides a channel for its insertion into the wound. In the bravo's daggers of Italy, a specimen of which from my collection is exhibited (Fig. 86), a similar provision for the insertion of the poison is effected by means of a groove on either side of the blade, communicating with two rows of small holes, into which the poison flows, and is retained in that part of the blade which enters the wound. Nearly similar blades, with holes, have been found in Ireland, of which a specimen is in the Academy's Museum, and they have been compared with others of the same kind from India, but I am not aware that there is any evidence to show that they were used for poison. Some of the Indian daggers, however, are constructed in close analogy with the poison apparatus of the serpent's tooth, having an enclosed tube running down the middle of the blade, communicating with a reservoir for poison in the handle, and having lateral openings in the blade for the diffusion of the poison in the wound. Similar holes, but without any enclosed tube, and having only a groove on the surface of the blade to communicate with the holes, are found in some of the Scotch dirks, and in several forms of *couteau de chasse*, in which they appear to have been used merely with a view of letting air into the wound, and accelerating death (Figs. 87*a* and *b*). The Scotch dirk, here represented, has a groove running from the handle along the back of the blade to within three and-a-half inches of the point. In the bottom of this groove ten holes are pierced, which communicate with other lateral holes at right angles, opening on to the sides of the blade. Daggers are still made at Sheffield for the South American market, with a small hole drilled through the blade, near the point, to contain the poison, and in my collection there is an iron arrow-point (Fig. 88), evidently formed of the point of one of these daggers, having the hole near the point.

It often happens that forms which, in the early history of an art, have served some specific object, are in later times applied to other uses, and are ultimately retained only in the forms of ornamentation. This seems to have been the case with the pierced work upon the blades of weapons which, intended originally for poison, was afterwards used as air-holes, and ultimately for ornament only, as appears by a plug bayonet of the commencement of the eighteenth century in the Tower Armoury, No. 390 of the official Catalogue, for a drawing of which, as

well as that of the Scotch dirk, I am indebted to Captain A. Tupper, member of the Council of this Institution.

The second point of analogy to which I would draw attention is that of the multi-barbed arrows of most savages to the multi-barbed stings of insects, especially that of the bee (Fig. 89), which is so constructed that it cannot usually be withdrawn, but breaks off with its poisonous appendage into the wound. An exact parallel to this is found in the poisoned arrows of savages of various races, which, as already mentioned, are frequently armed with the point of the sting ray, for the express purpose of breaking into the wound. In the arrows of the Bushmen, the shaft is often partly cut through, so as to break when it comes in contact with a bone, and the barb is constructed to remain in the wound when the arrow is withdrawn (Fig. 90). The same applies to the barbed arrows used with the Malay blowpipe (Fig. 91), and those of the wild tribes of Assam (Fig. 92), which are also poisoned. The arrow points of the Shoshones of North America (Fig. 93), said to be poisoned, are tied on purposely with gut in such a manner as to remain when the arrow is withdrawn. The arrows of the Macoushie tribe of Guiana (Fig. 94) are made with a small barbed and poisoned head, which is inserted in a socket in the shaft, in which it fits loosely, so as to detach in the wound. This weapon appears to form the link between the poisoned arrow and the fishing arrow or harpoon, which is widely distributed, and which I propose to describe on a subsequent occasion. Mr. Latham, of Wilkinson's, Pall Mall, has been kind enough to describe to me a Venetian dagger of glass, formerly in his possession; it had a tube in the centre for the poison, and the blade was constructed with three edges. By a sharp wrench from the assassin, the blade was broken off, and remained in the wound.

It has also been supposed that from their peculiar construction most of the triangular and concave-based arrow heads of flint that are found in this country and in Ireland were constructed for a similar purpose (Fig. 95).

The serrated edges of weapons, like those of the bee, and the sting-ray when used as arrow points, were likewise instrumental in retaining the poison and introducing it into the wound, and this form was copied with a similar object in some of the Florentine daggers above mentioned, a portion of the blade of one of which, taken from Meyrick's ancient arms and armour, is shewn in Fig. 96.*

Although the use of poison would in these days be scouted by all civilised nations as an instrument of war, we find it still applied to useful purposes in the destruction of the larger animals. The operation of whaling, which is attended with so much danger and difficulty, has of late been greatly facilitated by the use of a mixture of strychnine, and woorali the well-known poison of the Indians of South America. An ounce of this mixture, attached to a small explosive shell fired from a carbine, has been found to destroy a whale in less than eighteen minutes, without risk to the whaler.†

* Meyrick—Ancient Arms and Armour, vol. ii, Pl. cxiii, figs. 7, 13, 14.

† *Times* newspaper, 24th December, 1866.

When we consider how impotent a creature the aboriginal and uninstructed man must have been when contending with the large and powerful animals with which he was surrounded, we cannot too much admire that provision of nature which appears to have directed his attention, during the very earliest stages of his existence, to the acquirement of the subtile art of poisoning. In the forests of Guiana there are tribes, such as the Otomacs, apparently weaponless, but which, by simply poisoning the thumb nail with curare or woorale, at once become formidable antagonists.* Poison is available for hunting as well as for warlike purposes: the South American Indians eat the monkeys killed by this means, merely cutting out the part struck,† and the wild tribes of the Malay peninsula do not even trouble themselves to cut out the part before eating.‡ The Bushmen, and the Stiens of Cambodia use their poisoned weapons chiefly against wild beasts and elephants.

Thus we see that the most noxious of herbs, and the most repulsive of reptiles have been the means ordained to instruct mankind in what, during the first ages of his existence, must have been the most useful of arts. We cannot now determine how far this agent may have been influential in exterminating those huge animals, the elephas primigenius and rhinoceros tichorhinus, with the remains of which the earliest races of man have been so frequently associated, and which, in those primeval days, before he began to turn his hand to the destruction of his own species, must have constituted his most formidable enemies.

Missiles.—Amongst the offensive weapons of animals, the use of missiles cannot be altogether excluded, although the examples of its use by the lower creation are extremely rare. Some species of cuttle-fish have the power of ejecting water with a good aim.§ The toxotes, or archer-fish, obtains its name from its faculty of projecting drops of water at insects some three or four feet from the surface of the water, and which it seldom fails to bring down. The llama has a habit of ejecting its saliva, but I am not aware of the object of this singular practice. I only know from experience that its manners are offensive, and that it has the power of spitting with a good aim and for some distance. The porcupine has the power of throwing its quills, and is said to do so with effect, although it is not now believed to dart them with any hostile intention. The Polar bear is described in Captain Hall's recent publication as an animal capable of capturing the walrus by missile force. It is said that the bear will take advantage of an overhanging cliff, under which its prey is seen asleep upon the ice, to throw down with its paws, large stones, and with such good aim as to hit the walrus on the head, after which, running down to the place where the animal lays stunned, it will take the stone to beat out its brains. That animals are instinctively acquainted with the force of gravitation is evident by their avoiding precipices that would endanger

* Humboldt's Aspects of Nature, vol. i, pp. 25 and 103.

† Klemm.

‡ On the Wild Tribes in the Interior of the Malay Peninsula, by Père Bourien. Trans. Ethno. Soc., vol. iii, p. 78.

§ Darwin's Naturalist's Journey, p. 8.

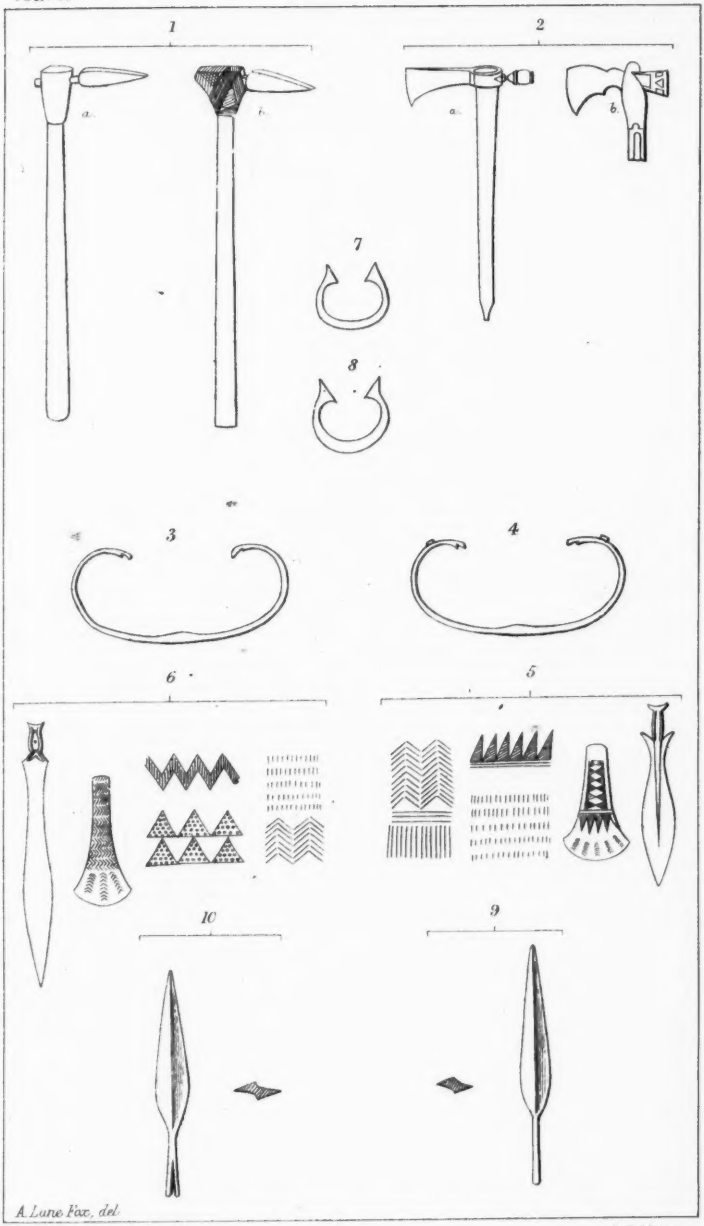
them, and it certainly requires a slight, but at the same time most important advance upon this knowledge to avail themselves of large stones for such purposes as are here attributed to the bear; but as the story only rests on the authority of the Esquimaux, it must, I think—although they certainly are careful observers of the habits of animals—be rejected, until confirmed by the direct testimony of white men. It has even been doubted whether the alleged habit of monkeys in throwing cocoa-nuts at their pursuers, has not arisen from the mistake of the hunter in supposing that fruit accidentally detached from their stalks by the gambols of these animals in the trees, may have been intended as missiles, but it appears now to be clearly established that monkeys have the intelligence, not only to throw stones, but even to use them in breaking the shells of nuts. Major Denham, in his account of his travels in Central Africa, near Lake Tshad, says:—"The monkeys, or "as the Arabs say, men enchanted, 'Beny Adam meshood,' were so "numerous, that I saw upwards of 150 assembled in one place in the "evening. They did not appear at all inclined to give up their ground, "but perched on the top of a bank, some 20 feet high, made a terrible "noise, and rather gently than otherwise, pelted us as we approached "within a certain distance." This, I think, is clear evidence of a combined pelting on the part of these untutored animals.

The monkey thus furnishes us with the only example of the use of any external substance for offensive purposes, by any member of the animal kingdom. All others, except, perhaps, the missile fishes above described, use, for offence and defence, the weapons with which nature has furnished them, and which are integral parts of their persons. It is this which so essentially distinguishes man from the lower creation. Man is the tool-using animal. We have no knowledge of man, in any state of existence, who is not so; nor have we (with the exception of the ape, the link indirectly connecting him with the lower creation, in the same manner that the savage connects the civilized with the aboriginal man, both being branches from the same stem) any knowledge of animals that employ tools or weapons. Herein lies the point of separation, which, in so far as the material universe is concerned, marks the dawn of a new dispensation. Hitherto Providence operates directly on the work to be performed, by means of the living, animated tool. Henceforth, it operates indirectly on the progress and development of creation, first, through the agency of the instinctively tool-using savage, and by degrees, of the intelligent and reasoning man.

DESCRIPTION OF THE PLATES.

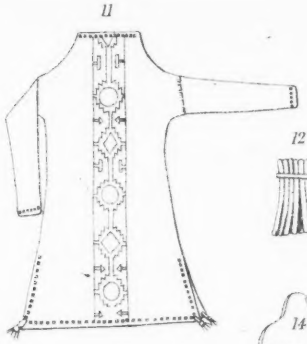
Plate XLVIII, fig. 1 (*a*).—Adze of iron, constructed by Captain Cook's armourer, for the use of the natives of Tahiti, after the model of their own—(*b*) of stone.

Plate XLVIII, fig. 2 (*a*).—A pipe-handled Tomahawk, of European manufacture, constructed for the North American Indians. Museum of the Royal United Service Institution.—Engraved Illustrations of Ancient Armour. Meyrick. Vol. 2, plate cxlix.—(*b*) a Pipe and Tomahawk of pipe stone used by the



A. Lane Fox, del.

J. Jobbins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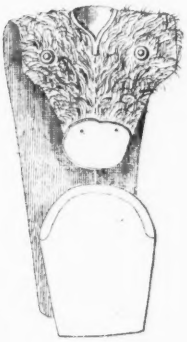

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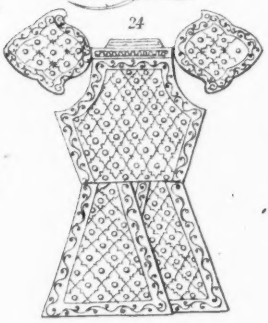
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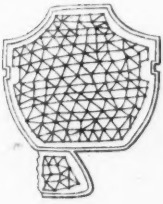
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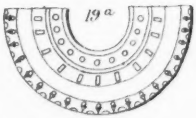
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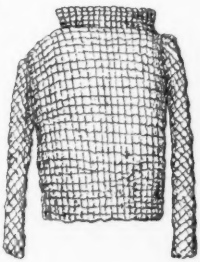
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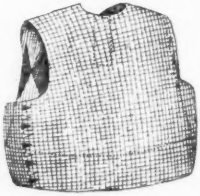

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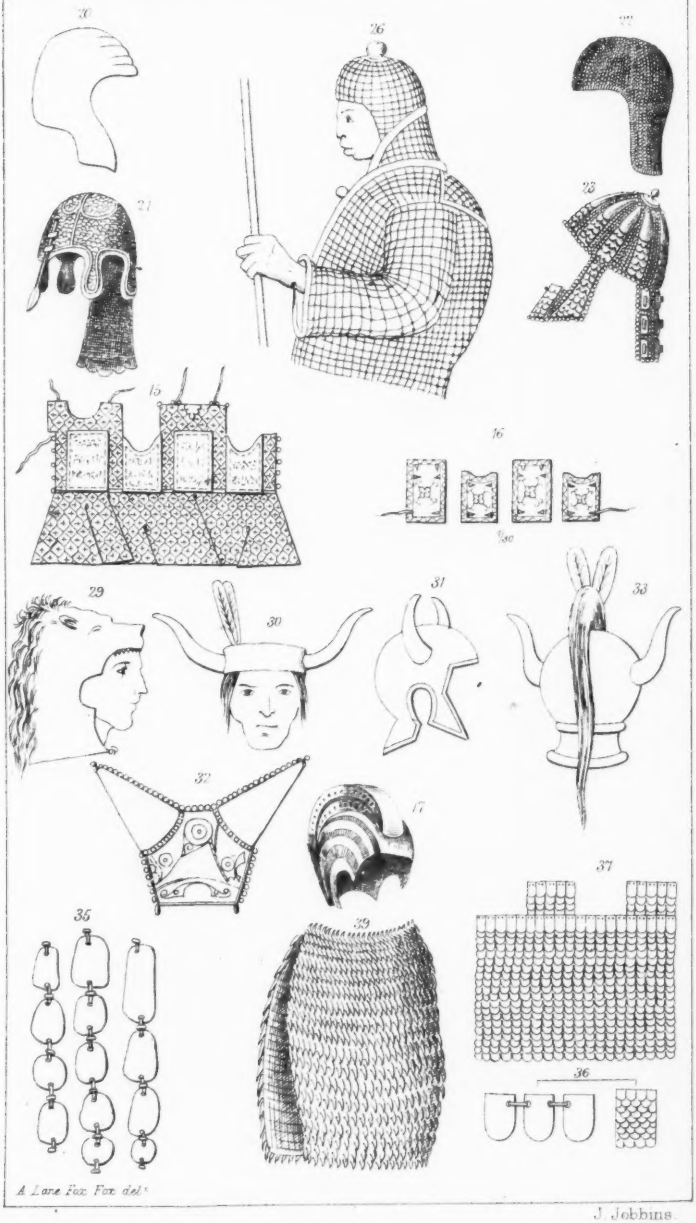
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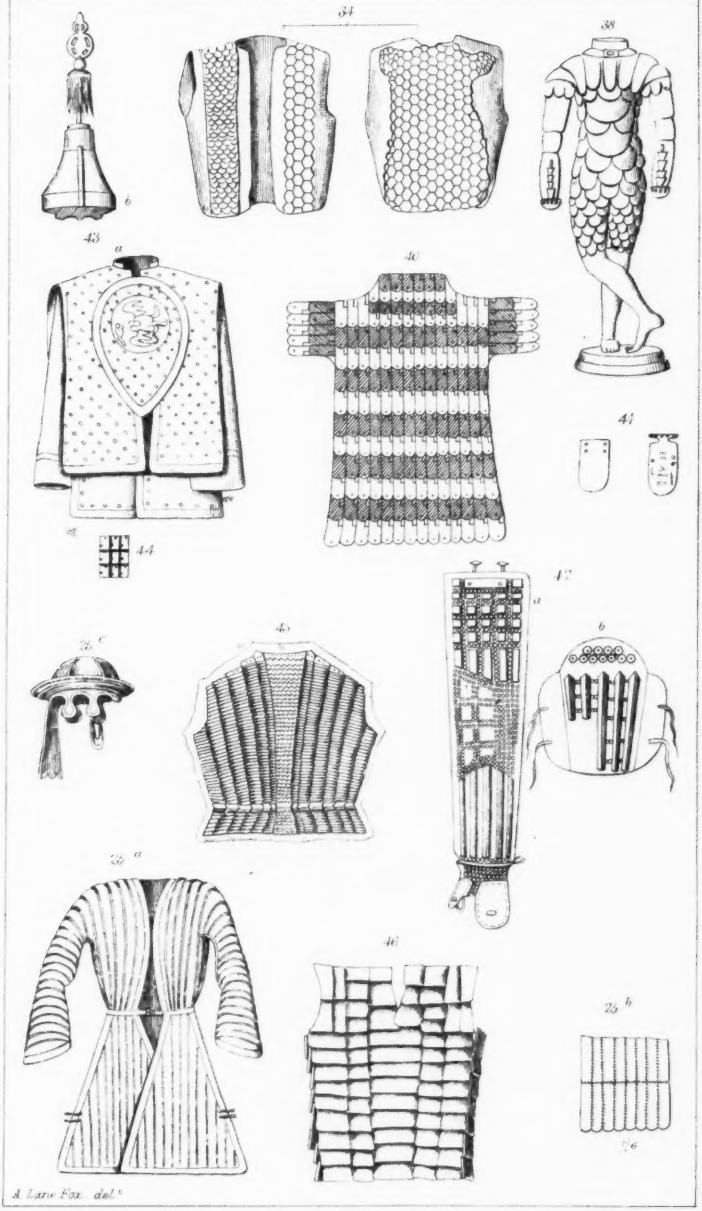
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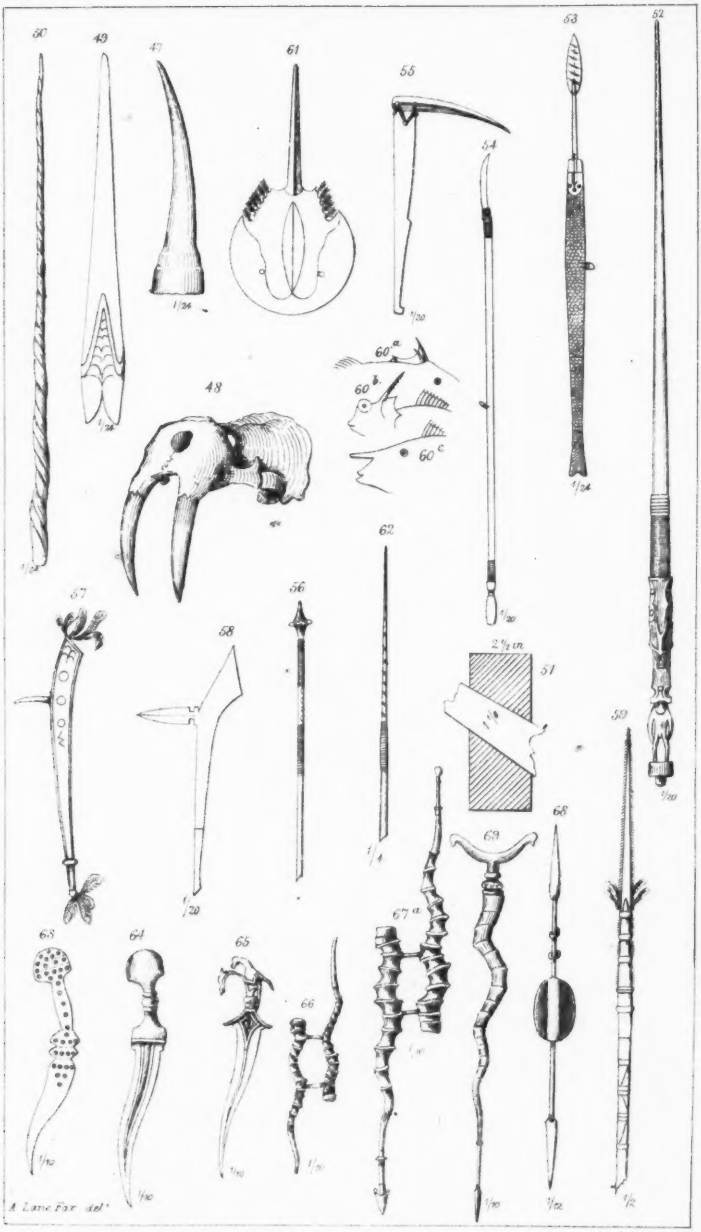
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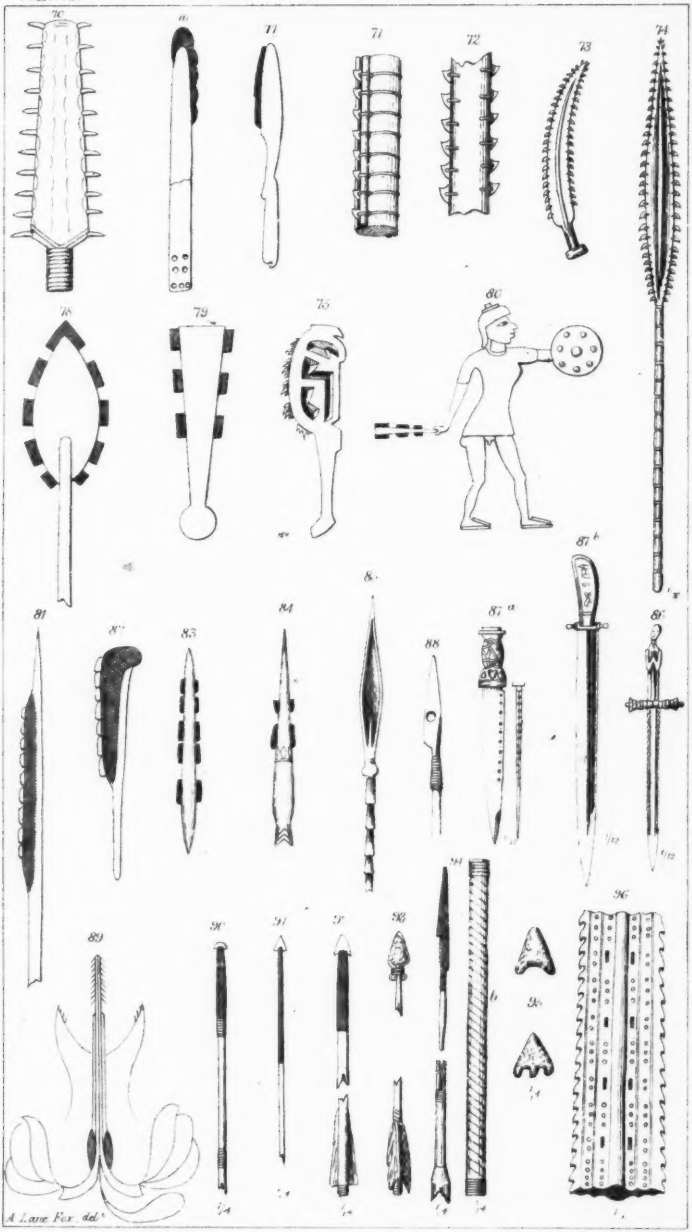
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J. Jobbins

Dacotas of North America—Schoolcraft. History of the Condition and Prospects of the Indian Tribes of the United States, Vol. 2, plate lxix.

Plate XLVIII, fig. 3.—A Mœotian, or Scythian Bow, from a fictile vase, represented in Hamilton's Etruscan Antiquities, Vol. 4, plate cxvi.—Critical Enquiry into Ancient Armour. Meyrick, Vol. 1, plate ii.—See also Rawlinson's Herodotus, Vol. 1.

Plate XLVIII, fig. 4.—Bow of the Tartar Tribes on the borders of Persia.—Engraved Illustrations of Ancient Armour. Meyrick, Vol. 2, plate cxliv.—Museum of the Royal United Service Institution.

Plate XLVIII, fig. 5.—Iron Sword of native manufacture, minus the wooden handle, and War Axe, both constructed by the Fans of the Gaboon country, West Africa. From Colonel Lane Fox's Collection. A nearly similar axe is in the Museum of the Royal United Service Institution. The patterns of ornamentation are taken, partly from the Fan War Axe, and partly from some knives of iron brought from Central Africa, by Mr. Petherick, and now in Colonel Fox's Collection.

Plate XLVIII, fig. 6.—Leaf-shaped Bronze Sword, minus the handle, from Ireland. Col. Fox's Collection.—A Bronze Celt, in the Museum at Maintz.—Die Alterthümer unserer heidnischen Vorzeit. L. Lindenschmit. The patterns of ornamentation are taken partly from Lindenschmit, Plate iii, and partly from illustrations of Irish bronze ornamental work in the Illustrated Catalogue of the Royal Irish Academy, by R. W. Wilde, M.D., M.R.I.A. Bronze, pp. 389, 390.

Plate XLVIII, fig. 7.—A Manilla, or specimen of the ring money of copper and iron, used as a medium of exchange in the Eboe country, West Africa. From Colonel Lane Fox's Collection.—In 1836, a ship laden with a quantity of these Manillas, made in Birmingham, after the pattern in use in Africa (the specimen here figured forming part of the cargo), was wrecked on the coast of the county of Cork. By this means their exact resemblance to the gold and bronze Penanular rings found in Ireland (Fig. 8), attracted the notice of Mr. Sainthill, of Cork, by whom the subject was communicated to the *Ulster Journal of Archæology*, No. 19, July, 1857.

Plate XLVIII, fig. 8.—A Penanular Ring, found in Ireland. Wilde's Catalogue of the Royal Irish Academy. Bronze, p. 570. Gold, p. 53.—Similar forms are found in England, and on the Continent. Linderschmit Tafel iv; Keller, Plate lii *a*, fig. 9.

Plate XLVIII, fig. 9.—A Caffre Assegai-head of Iron, of native manufacture, with section of blade. Museum of Royal United Service Institution.

Plate XLVIII, fig. 10.—A Saxon Spear-head of Iron, having the same sectional form as Fig. 9. Found in the Saxon graves.—Neville's Saxon Obsequies.—Akerman's Pagan Saxendon.

Plate XLIX, fig. 11.—War Dress of a Patagonian Chief, composed of seven thicknesses of hide on the body part, and three on the sleeves.—Museum of the Royal United Service Institution.

Plate XLIX, fig. 12.—Section of the above armour upon the breast, showing the manner in which the seven thicknesses are united at top.

Plate XLIX, fig. 13.—Kayan Cuirass and Helmet. The helmet of cane wickerwork. The cuirass of untanned hide, having the hair on the outside.—Museum of the Royal United Service Institution, presented by Captain D. Bethune, R.N.

Plate XLIX, fig. 14.—An Egyptian Breast-plate, made of a crocodile's back.—Engraved Illustrations of Ancient Armour. Meyrick, Skelton, Vol. 2, plate cxlviii.

Plate L, fig. 15.—A suit of Armour, supposed formerly to have belonged to the Rajah of Guzerat. The four breast and back pieces are of rhinoceros hide, having an inscription upon them, beginning with an invocation to Ali. The remaining portions are of black velvet, ornamented with brass studs, and padded.—Engraved illustrations of Ancient Armour. Meyrick, Skelton. Vol. 2, plate cxli.

Plate L, fig. 16.—Four plates of steel, of similar form to those of rhinoceros hide in the preceding figure. They are fastened with straps over a coat of chain armour, and are called, in the Persian language, "char aineh," *i. e.* "the four mirrors." They are ornamented with patterns of inlaid gold.—Museum of the Royal United Service Institution.

Plate L, fig. 17.—A Helmet of Basketwork, from the Sandwich Islands, resembling the Grecian in form.—Museum of the Royal United Service Institution, presented by H. Shelley, Esq.

Plate XLIX, fig. 18.—A Suit of Armour of cocoa-nut fibre, from Pleasant Island, in the Pacific ocean.—Museum of the Royal United Service Institution, presented by Colonel Sir G. Arthur. It is probable that the under tippet, which is now attached to the back and breast piece at the top, may originally have been intended to be worn round the loins, like a kilt.

Plate XLIX, fig. 19 (*a*).—Quilted Pectoral of the Egyptians.—Critical Enquiry into Ancient Armour. Meyrick, Vol 1, plate i.—(*b*) shows the manner in which it was worn, and is taken from a figure in Rawlinson's Herodotus.

Plate L, fig. 20.—Quilted Head-dress of the Egyptian Soldiers.—Critical Enquiry into Ancient Armour. Meyrick, Vol. 1, plate i.

Plate L, fig. 21.—Quilted Helmet of nearly the same form as the above, from India. Colonel Fox's Collection.

Plate L, fig. 22.—A Head-dress of nearly the same form as figs. 20 and 21, belonging to the Nouaer tribe of Negroes, inhabiting both sides of the Nile from 8° to 10° N. latitude, brought to England by Mr. Petherick, and now in Colonel Fox's Collection. It resembles the Egyptian very closely, and is composed of cylindrical white beads, fastened together with a kind of string. The beads are of European manufacture.

Plate L, fig. 23.—A Helmet of the same form as fig. 21, composed of united mail and plate, formerly belonging to the Body Guard of the Moguls.—Colonel Fox's Collection.

Plate XLIX, fig. 24.—A Suit of Quilted Armour, taken in action from Koer Singh, the famous Rajpoot Chief, of Jugdespore in Behar, on the 12th of August, 1857, by Major Vincent Eyre, commanding the field force that relieved Arrah.—Museum of the Royal United Service Institution, presented by Major-General Sir Vincent Eyre, K.C.S.I., C.B.

Plate LI, fig. 25 (*a*).—Suit of Quilted Armour, found upon the body of Tippoo Saib at his death, in the breach of Seringapatam. Upon the breast, this armour consists of two sheets of parchment, and nine thicknesses of quilting, composed of cocoons of the "Saturnia Mylitta," stuffed with the wool of the "Eriodendron Anfractuosum, D.C.," a jungle plant, and neatly sown together, as represented in fig. 25 (*b*).—Museum of the Royal United Service Institution.

Plate LI, fig. 25 (*b*).—A portion of one of the nine thicknesses of quilting of the above, reduced to $\frac{1}{8}$th the natural size.

Plate LI, fig. 25 (*c*).—Tippoo Saib's Helmet; belongs to the above suit.—Museum of the Royal United Service Institution.

Plate L, fig. 26.—Quilted Armour of the Bornouese Cavalry.—Travels of Denham and Clapperton.

Plate XLIX, fig. 27.—A Suit of Armour from the Navigator's Islands, composed of cocoa-nut fibre, coarsely netted.—Museum of the Royal United Service Institution; presented by Sir W. Burnett, M.D.—Similar armour is used in the King's Mill Group.

Plate XLIX, fig. 28.—Part of a Chinese Brigandine Jacket of cotton, quilted with enclosed plates of metal.—Museum of the Royal United Service Institution.

Plate L, fig. 29.—Head-dress of Hercules wearing the Lion's Skin, from a Bronze in the Blacas Collection, British Museum.

Plate L, fig. 30.—Head-dress of a North American Indian Chief.—Schoolcraft. History, condition, and prospects of the Indian Tribes, Vol. iii, p. 68 plate x.

Plate L, fig. 31.—Thracian Helmet of Brass, with horns of the same—Critical Enquiry into Ancient Armour. Meyrick, Vol. 1, plate iii.

Plate L, fig. 32.—Ancient British Helmet of Bronze, with straight horns of the same, found in the Thames.—British Museum.

Plate L, fig. 33.—Greek Helmet, having horns of brass.—Critical Enquiry into Ancient Armour. Meyrick, Vol. 1, plate iv.

Plate LI, fig. 34.—Back and Breast-piece of the Bugo Dyaks, armed with the Scales of the Pangolin.—Museum of the Royal United Service Institution.

Plate L, fig. 35.—A piece of Bark from Tahiti, studded with pieces of cocoa-nut shell.—Museum of the Royal United Service Institution.

Plate L, fig. 36.—Fragment of Scale Armour of Horn, found at Pompeii.—Pictorial Gallery of Arts, Vol. 1, figs. 10, 61.

Plate L, fig. 37.—A piece of Scale Armour, made of the hoofs of some Animal, from some part of Asia: said to be from Japan.—Critical Enquiry into Ancient Armour.—Meyrick, Vol. 1, plate iii.

Plate LI, fig. 38.—An ancient Stone Figure in scale armour, having an inscription in a character cognate to the Greek, but in an unknown language.—Cuming on Weapons of Horn, Journal of the Archæological Association, vol. iii.

Plate L, fig. 39.—Back and Breast-piece of Armour from the Sandwich Islands, composed of seal's teeth.—Museum Royal United Service Institution; presented by H. Shelley, Esq.

Plate LI, fig. 40.—An Egyptian Suit of Scale Armour.—Rawlinson's Herodotus.—See also Sir Gardiner Wilkinson.

Plate LI, fig. 41.—Two Scales of Egyptian Scale Armour, enlarged.—Rawlinson's Herodotus.

Plate LI, fig. 42.—Japanese Armour, composed of chain, plate, and enclosed quilted plates.—Colonel Fox's Collection.—(*a*) Left arm; (*b*) Greaves.

Plate LI, fig. 43 (*a*).—A Suit of Chinese Armour of cotton, having iron scales attached to the inside.—Museum Royal United Service Institution; presented by Captain Sir Edward Belcher, R.N.

Plate LI, fig. 43 (*b*).—Iron Helmet of the above suit.

Plate LI, fig. 44.—A portion of the iron scales attached to the inner side of the above suit.

Plate LI, fig. 45.—The inner side of a Breast-piece of Jazerine Armour of iron scales, of the fifteenth or sixteenth century.—Colonel Fox's Collection. See also Grose's Treatise on Ancient Armour, pl. 30.—Critical Inquiry into Ancient Armour, Meyrick, vol. vii, pl. lvi.

Plate LI, fig. 46.—A Brigandine composed of large iron scales on the outside, probably of the same date as the above; left by the Venetians in the armoury of Candia on the surrender of that island to the Turks in 1715, and presented to the Museum of the Royal United Service Institution by Lieutenant-Colonel Patrick Campbell, R.A.

Plate LII, fig. 47.—Horn of the Rhinoceros.—Colonel Fox's Collection.

Plate LII, fig. 48.—Skull and Tusks of the Walrus.—Colonel Fox's Collection.

Plate LII, fig. 49.—Weapon of the Sword Fish; scale half inch to one foot.—Colonel Fox's Collection.

Plate LII, fig. 50.—Spear of the Narwhal; scale half inch to one foot.—Colonel Fox's Collection.

Plate LII, fig. 51.—Section, showing part of the timber of the ship "Fame," where it was pierced by the narwhal in the South Seas, through 2½ inch oak. The piece of the timber containing the portion of the tusk which had broken off in the ship's bottom was presented to the Museum Royal United Service Institution by Lieutenant A. T. Tulloch, R.A.

Plate LII, fig. 52.—An Esquimaux Spear, from Greenland, armed with the spear of the narwhal.—Museum of the Royal United Service Institution. The wooden handle is ornamented with two human figures, carved in relief; reduced to $\frac{1}{20}$th its natural size.

Plate LII, fig. 53.—Esquimaux Spear, constructed in the form of a fish, having a

fore-shaft composed of the narwhal's tusk, inserted so as to represent the tusk of the animal; scale half-inch to one foot. Colonel Lane Fox's Collection.

Plate LII, fig. 54.—Esquimaux Lance, pointed with a walrus tooth.—Museum Royal United Service Institution; reduced $\frac{1}{20}$th.

Plate LII, fig. 55.—Esquimaux Tomahawk or Pickaxe, headed with the tooth of a walrus.—Museum Royal United Service Institution; reduced $\frac{1}{20}$th.

Plate LII, fig. 56.—Arrow Head, probably from South America, headed with the point of a deer's horn.—Christy Collection.

Plate LII, fig. 57.—War Club of the Iroquois, called "GA-NE-U-GA-O-DUS-HA," or "Deer-horn War Club."—League of the Iroquois, by Louis Morgan.

Plate LII, fig. 58.—North American Indian Club, with a point of iron.—Museum Royal United Service Institution; presented by T. Hoblyn, Esq.; reduced $\frac{1}{20}$th.

Plate LII, fig. 59.—Arrow, armed with the weapon of the ray, probably the "Trygon Histrix," from South America.—Museum Royal United Service Institution; reduced $\frac{1}{2}$.

Plate LII, fig. 60 (*a*).—Spine of the "Balistes Capriscus" erect.—Yarrell's British Fishes.

Plate LII, fig. 60 (*b*).—Horn of the "Cottus Diceraus." Pall.—From Cuvier's Plates.

Plate LII, fig. 60 (*c*).—Horn of the "Naseus Fronticornis." Lac.—From Cuvier's Plates.

Plate LII, fig. 61.—Spear of the "Limulus," or "King Crab."

Plate LII, fig. 62.—Arrow, armed with the spine of the "Diodon."—Colonel Lane Fox's Collection; reduced $\frac{1}{4}$.

Plate LII, fig. 63.—Kanjar, or Indian Dagger, composed of the horn of the buffalo, having the natural form and point.—Colonel Lane Fox's Collection; reduced $\frac{1}{10}$th.

Plate LII, fig. 64.—Ditto, with metal blade, of the same form, having an ivory handle.—Colonel Lane Fox's Collection; reduced $\frac{1}{10}$th.

Plate LII, fig. 65.—Ditto, of the same form, having both blade and handle of iron. The handle is ornamented with the figure of a bird, and some small quadruped.—Colonel Lane Fox's Collection; reduced $\frac{1}{10}$th.

Plate LII, fig. 66.—Dagger formed of the horn of the sassin, or common antelope.—Colonel Lane Fox's Collection; reduced $\frac{1}{10}$th.

Plate LII, fig. 67.—Ditto, the points armed with metal.—Museum Royal United Service Institution; reduced $\frac{1}{10}$th.

Plate LII, fig. 68.—Ditto, of nearly the same form and use, composed entirely of metal, and having a shield for the hand.—Museum Royal United Service Institution; reduced $\frac{1}{12}$th. Similar shields are sometimes attached to those figured in figs. 66, 67.

Plate LII, fig. 69.—Weapon composed of the horn of the antelope; steel pointed; supposed to be that used by the Fakirs in India.—Colonel Lane Fox's Collection.

Plate LIII, fig. 70.—Sword formed of the serrated blade of the saw-fish from New Guinea.—Museum of the Royal United Service Institution.

Plate LIII, figs. 71, 72, 73, 74.—Weapons from the Pacific Ocean, edged with the teeth of the shark. The teeth near the points are placed points forward; the remainder with the points towards the handle. Two methods of fastening the teeth are shown; in grooves, and lashed between two strips of wood.—Museum of the Royal United Service Institution.

Plate LIII, fig. 75.—Implement from New Zealand, armed with sharks' teeth.—British Museum.

Plate LIII, fig. 76.—Esquimaux Knife, armed with pieces of meteoric iron, from Davis Strait.—British Museum.

Plate LIII, fig. 77.—Knife, armed with pieces of iron along the edge, from Greenland.—Christy Collection.

Plate LIII, figs. 78, 79, 80.—The Mexican Maquahuilt.—From Lord Kingsborough's work on Mexican Antiquities.

Plate LIII, figs. 81, 82.—Spear and Knife, from Australia, armed with pieces of obsidian, or rock crystal.—Museum of the Royal United Service Institution.

Plate LIII, fig. 83.—Bone Arrow-point, armed with a row of sharp flint flakes on each side.—Museum of Professor Nilsson, at Lund, in Sweden. Reduced to one-half, from the figure in Wilde's Illustrated Catalogue of the Royal Irish Academy, Animal Materials, p. 254.

Plate LIII, fig. 84.—A similar implement to the above, in the Copenhagen Museum. —From the Illustrated Catalogue of the Copenhagen Museum.

Plate LIII, fig. 85.—Hollow Bone Arrow-point, from South America, the hollow of the bone being filled with poison.—Museum of the Royal United Service Institution.—Colonel Lane Fox's collection.

Plate LIII, fig. 86.—An Italian Bravo's Dagger, with grooves and holes to contain the poison. The handle represents a monk in the act of supplication.—Colonel Lane Fox's Collection.

Plate LIII, fig. 87 (*a*).—A Scotch Dirk, pierced with holes along the back and sides. A groove runs along the back of the blade eight inches in length, in which holes are pierced that communicate with lateral holes on the side of the blade.—Captain A. Tupper's Collection.

Plate LIII, fig. 87 (*b*).—A Couteau-de-Chasse, having two grooves on each side near the back of the blade, which is pierced through with holes.—Colonel Lane Fox's Collection.

Plate LIII, fig. 88.—Arrow Head, of iron, with a hole near the point for poison, from South America.—Colonel Lane Fox's Collection.

Plate LIII, fig. 89.—The Serrated or Multi-barbed Sting of the Bee.—Huber on Bees.

Plate LIII, fig. 90.—Point of the Bushman's Arrow, barbed with an iron head. The head is constructed to come off in the wound.—Colonel Lane Fox's Collection; reduced $\frac{1}{4}$.

Plate LIII, fig. 91.—Iron-headed Arrow of the Maay Blow-pipe; similarly constructed.—Colonel Lane Fox's Collection; reduced $\frac{1}{4}$.

Plate LIII, fig. 92.—Similarly constructed Arrow of the wild tribes of Assam, headed with copper; reduced $\frac{1}{4}$.—Colonel Lane Fox's Collection.

Plate LIII, fig. 93.—Flint Arrow Head of the Shoshones of North America; constructed to come off in the wound.—Schoolcraft, vol. i, p. 212–13.

Plate LIII, fig. 94.—Arrow Point of the Macoushie Indians of South America; constructed so as to detach in the wound; reduced $\frac{1}{4}$.—Colonel Lane Fox's Collection; presented by the Rev. J. G. Wood, M.A., F.L.S.

Plate LIII, fig. 95.—Flint Arrow Heads, from the north of Ireland.—Colonel Lane Fox's Collection; reduced $\frac{1}{4}$.

Plate LIII, fig. 96.—Part of the serrated and pierced Blade of an Italian Dagger; full size.—Engraved illustration of Ancient Armour, Meyrick, Skelton, vol. ii, pl. cxiii.

Evening Meeting.

Monday, June 24th, 1867.

VICE-ADMIRAL SIR H. J. CODRINGTON, K.C.B., in the Chair.

NAMES of MEMBERS who joined the Institution between the 17th and 24th June, 1867.

ANNUAL.

Vaughan, Hon. E. C., Lieut. Rifle Brigade. 1*l.*
Eyre, Henry R., Capt. Coldstream Guards. 1*l.*

A NEW MODE OF MARINE PROPULSION.

By Captain C. H. SIMPSON, R.N.

IT is with considerable diffidence that I have undertaken to read a paper upon so important and difficult a subject as "marine propulsion," especially as I am aware that amongst my hearers are men eminent alike for their scientific acquirements and practical experience; but as persons who have no such claims to consideration, have sometimes hit upon valuable ideas, I propose to bring to your notice this evening a plan, the result of not simply a happy idea, but of constant thought and frequent experiment during the last ten years. The experiments have, unfortunately, been on too small a scale to be considered decisive, but sufficient, I think, to intimate with tolerable certainty the result to be anticipated.

It may be as well for me to mention here the results I considered necessary of attainment, in a good propeller.

1stly, and most important, speed.

2ndly. Not to interfere with the gun-decks; and freedom from fouling by rigging, &c. shot away in action, with perfect security from injury by enemies' shot, &c.

3rdly. Manœuvring powers.

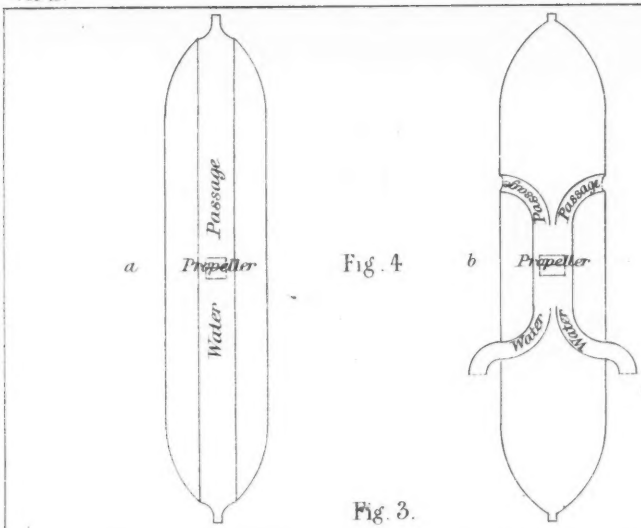
4thly. Non-interference with the sailing qualities of the vessel.

5thly. Economy of space.

6thly. Reduction of expense.

How near I have approached to the attainment of any of these objects, I will presently ask you to consider; but, before doing so, I will state shortly the steps by which I have arrived at my present plan.

I started with the conviction, that my object was to be attained only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Passage
Propeller
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Fig. 4
b
Passage
Passage
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Fig. 3.

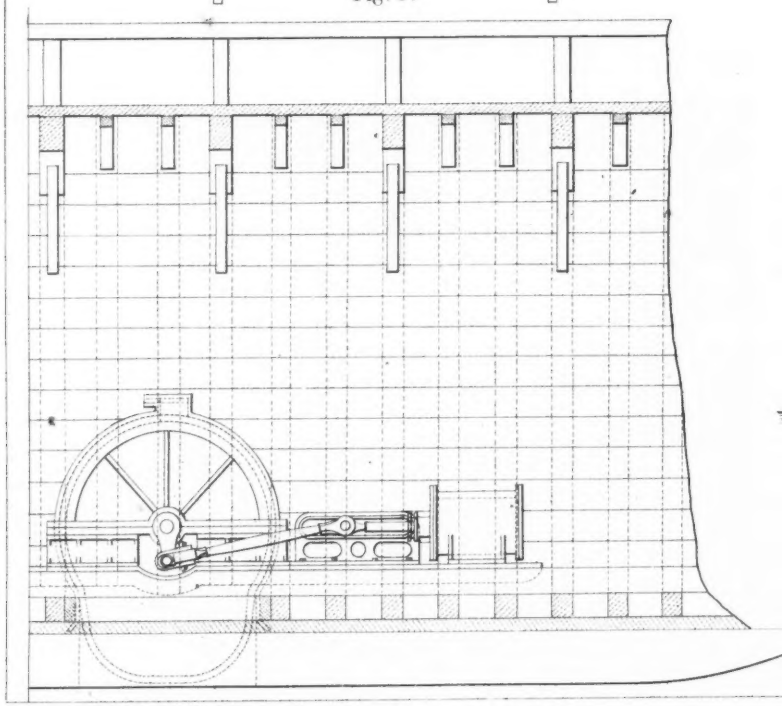


Fig. 1.

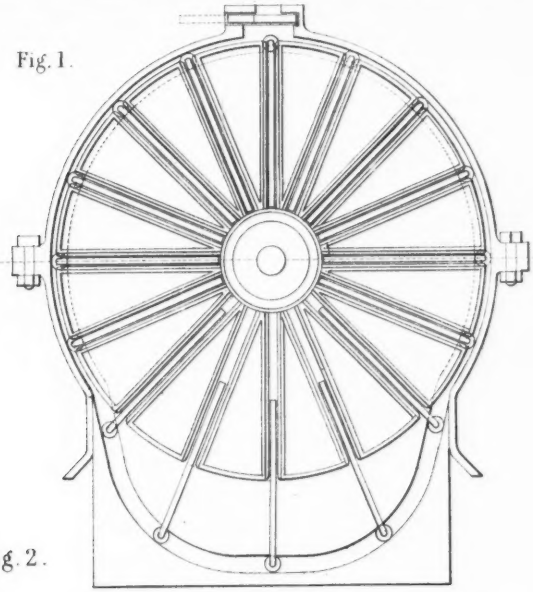
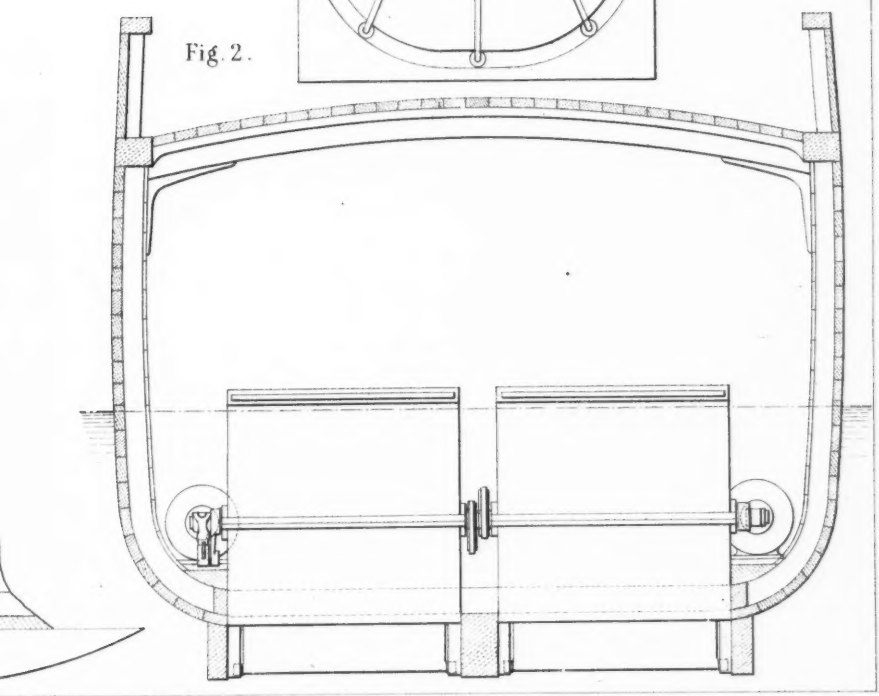


Fig. 2.



J. Jobbins.

by means of an internal propeller, that is to say, by some method of taking the water into the ship, and driving it out again.

It would be both tedious and unnecessary to explain the various modifications of plunges and squirts I devised and experimented upon; it will be sufficient for me to say, that it gradually dawned upon me that no plan could possibly be successful that did not drive the water through the vessel in a continuous stream without check. This being the case, it may occur to many, that my ideas were realised in the hydraulic propeller as patented by Mr. Ruthven. This, however, was not so; I had studied Mr. Ruthven's plan with great attention, and for reasons, which I purpose to explain presently, I rejected it.

I therefore followed out my own ideas, which I embodied about four years ago in the model before you, and which you will perceive embraces the idea of a straight internal passage for the water leading directly through the vessel, Plate liv, fig. 4*a*; both ends of the vessel are alike, with a balanced rudder at each end working across the water-passage so as to feel the whole benefit of the stream, and alter its direction at pleasure. For instance, if both tillers are put over to starboard, the bow-rudder will divert the stream entering from right ahead, and oblige the propeller to draw it in on the port bow, whilst the after-rudder will receive the whole force of the stream as it issues from the passage, and divert it to the port quarter, and thus by a combined rudder and water action, if I may use the expression, acting at the extreme ends, pivot the vessel on her centre.

My method of propulsion is as follows, and consists of a hollow cylinder or drum (Fig. 1), closely fitted in a casing, but with sufficient room to revolve freely therein; it is mounted on an axis, by which it is driven in the manner of a paddle-wheel. The hollow drum is furnished with a number of slits or casings, disposed radially, and open at the circumference. In these casings which each extend the length of the cylinder, are fitted pallet-, or float-boards, by which the propulsion is effected. These floats slide in a radial direction, and are capable of projection beyond the periphery of the cylinder to an extent to offer the requisite amount of surface to the water for propulsion.

The position of the floats is controlled and regulated by pins or studs (with or without truck-rollers or wheels), projected from each end of the floats. The pins or studs travel in cam-grooves in the outer casing, so arranged as to project or withdraw the floats during the proper periods in the revolution of the drum or wheel. The case enclosing the drum or wheel has an arc or section removed at the part where the floats are projected from the drum; this opening in the case may either be united with a channel passing through the body of the ship, or it may be united with the sides or bottom of the ship; so that the floats, when so projected, pass into and operate on the external water.

This wheel being hollow, and wholly, or almost wholly below the water-level, will, by its buoyancy, relieve the bearings of weight and friction.

When, in order not to interfere with the sailing qualities of th

vessel, it is desirable to withdraw the whole of the floats within the periphery of the wheel, it is simply necessary, by means of points, similar to those used on a railway, to alter the course of the cam-grooves in the outer casing. This casing is, of course, water-tight, and is fitted with a semi-circular slide, which, when the floats are turned off within the barrel, is closed, thus shutting off all communication with the outer water, and enabling repairs, &c., to be carried on in any weather.

It may be observed, that my invention of the sliding float, worked by a stationary cam-groove, could be applied so as to drive the water in any direction in a continuous stream through the vessel without check, and was also applicable for external propulsion.

It became an interesting question to ascertain which of the two modes of application would be preferable.

I therefore fitted a small boat, about 7 feet long and 18 inches beam, with my propeller, with the floats projecting through the bottom of the boat and acting on the external water (the motive power used to drive the propeller being a powerful piece of clockwork). The boat was placed in the water with her stem against the bank, and the clockwork being wound up, it was started, and the time that was taken to unwind five turns of the spring accurately noted; this was invariably 70 seconds. After this was done repeatedly, and not a second's variation in the time observed, the boat was taken out of the water and a false bottom, of about 18 inches in length, fitted over the floats, thus making a clear, straight passage, open fore and aft, of a size exactly corresponding to the full projection of the float. The boat was then placed in the water as before, and the clockwork started, when the five turns of the spring were invariably unwound in 55 seconds, thus practically showing the greatly superior resistance offered to the action of the floats by the external water, to that offered by water in a tube or passage.

Now, I am aware that I am venturing on dangerous ground when I attempt to state the cause of this difference; we are pretty safe as long as we keep to facts, but may very soon get bowled over if we venture to account for them. As however, I believe that the object of this Institution is not simply to record a number of facts, however interesting, but to promote discussion, I shall not hesitate to state my own ideas on this and other points connected with my subject, feeling assured that my doing so will not be considered presumptuous.

I believe, then, that the cause of this great difference in the resistance offered, to be due to the fact that in the tube or passage, an area of float-board equal to only one whole float meets with any resistance at one time, but that this resistance will be equal to the true theoretical resistance due to the reaction of water discharged at a given velocity. Whilst in the case of the propeller acting on the external water, the whole area of float-board equal to two floats, that in my case are always extended, bore a portion of the resistance felt, and that as the velocity of the vessel, through the water, is increased, so will the resistance on the whole of this area approximate more nearly to this theoretical resistance; and though, practically, this float-surface may

never quite meet with double the resistance of the internal propeller, I can imagine its doing so very nearly, and hence I argue, that the size of the propellers and their floats being equal, the propeller acting on the external water must give a far higher speed with a given power, than the propeller acting in the through passage.

I should now like to say a few words on the hydraulic mode of propulsion, on account of the intimate connection it has with the ideas and experiments I have been endeavouring to describe to you. It is, in fact, an internal propeller of somewhat different form from mine, but dependent for its propelling power upon similar principles, viz., the reaction due to the water discharged at a given velocity. For instance, supposing I were to block up my water passage before and abaft the propeller, and introduce tubes so as to carry the water out and bring it in through the sides of the vessel, Fig. 4*b*; I have only to fit the nozzles or discharge-pipes on the ends of the upper tubes, and I have the hydraulic propeller, not the turbine-wheel, but the hydraulic propeller.

In considering, then, the two plans, the question arises which is the most convenient form of application—to use the straight passage, and thus to communicate the pressure due to the reaction of the water, directly through the float to the vessel, or by making the water take an indirect course, cause the pressure due to its reaction to be felt at the back of the discharge-pipes.

Now, if we put the question of friction on one side, and suppose two similar vessels of the same engine power, fitted with propellers one on each of these plans, we should find, as long as the vessels were stationary, that each would drive out, or discharge the same weight or quantity of water; but when we come to compare the action of the two plans with the vessels in motion, we shall see a great difference. For instance, suppose the vessel with the straight through-passage to be moving at the rate of 9 knots, or 15 feet per second, through the water, as there is no friction, the water will flow through the passage of its own accord at that rate, and the floats of the propeller would have to travel at that velocity + the velocity necessary to accumulate upon them a pressure or resistance equal to the moment of resistance of the ship (as is the case with the ordinary paddle-wheel). If we suppose this to be $7\frac{1}{2}$ feet per second, the power used will be that of a weight equal to the moment of resistance of the ship, moved with a velocity of $22\frac{1}{2}$ feet per second.

With the hydraulic propeller however this is very different. The water discharged, and its consequent reaction at the back of the discharge-pipes, will be the same, whether the vessel be at rest or moving through the water, consequently if her discharge pipes are equal in area to the float surface, and no other retarding force peculiar to the plan be brought into play, the power required to propel her 15 feet per second would be only that of a weight equal to the moment of resistance of the ship for that speed, moved with the velocity of $7\frac{1}{2}$ feet per second, or one-third of the power required in the other vessel.

But there is, I believe, a most important retarding force brought into play, and I believe it to be this. The water that is taken into

the vessel when she is in motion is taken from a state of rest, and is not only driven through the tubes and passages by the engine, but is also carried forward by the ship, and consequently the momentum of the ship is destroyed by a force equal to that required to move the quantity of water taken in in a given time, a velocity equal to that of the ship's motion, and consequently that water must be discharged in the opposite direction with a similar velocity before its reaction at the back of the discharge-pipes will counterbalance this loss, and the excess of the velocity at which the water is driven through the discharge-pipes, over that of the ship, is alone available for propulsion, or, in other words, for overcoming the moment of resistance of the ship. It is evident, therefore, according to its principle, that in order to get an available pressure at the back of the discharge-pipes equal to the moment of resistance of the ship, the engine must be sufficiently powerful to drive the water through the discharge-pipes with the velocity of the ship + the velocity necessary to accumulate that additional resistance.

I will try and illustrate this principle from the information I have been able to obtain about the "Waterwitch." That information, I am sorry to say, is very meagre, and is, in fact, chiefly limited to what I was enabled to gather from Admiral Elliot's lecture the other night: it is this, that the speed of the "Waterwitch" was roughly nine knots, the velocity of the discharge of water was double the speed of ship, or 30 feet per second, and I have also ascertained that the area of each discharge-pipe is 480 square inches, or both together 960 square inches. The reaction, therefore, due to that area and velocity of discharge is roughly 12,000 lbs., which equals the gross moment of resistance of the ship; but according to my theory, the net or true moment of resistance, that offered to the ship's passage by the external water, will be this pressure—the pressure due to the reaction of discharge at 15 feet per second (the velocity of ship) = to 3,000 lbs.; consequently 9,000 lbs. is the net moment of resistance, and the 3,000 lbs. represents the retarding force. The net indicated horse-power required to propel the ship 9 knots, or 15 feet per second, will, therefore, be about 655. Any horse-power above this that may have been used, is absorbed in friction. I believe the total indicated horse-power used, to have been about 830.

The question is, is this a satisfactory result? I see in the account of the "Rattler's" experiments (a vessel of 888 tons), that with a horse-power calculated from dynamometer of 219 she obtained a speed of 9½ knots. The net indicated horse-power, which includes the loss due to the angle of incidence of the screw-blades, was 309, and the gross horse-power, which includes friction also, was 428. The moment of resistance of ship calculated from dynamometer was 7,530 lbs. Now, evidently, according to my calculation, the lines of the "Waterwitch" are very inferior to those of the "Rattler," but the difference in power used for the same speed is as two to one; and if my idea of this mode of propulsion (the hydraulic) is correct, the lines will make less difference in the speed of a vessel propelled by it, than with any other mode of propulsion.

But it becomes an interesting question to ascertain what would be the effect of increasing the size of the discharge-pipes. I believe that if the discharge-pipes in the "Waterwitch" were increased to four times their present area, or 3,840 square inches, the result would be nearly as follows:—Pressure at the back of discharge-pipe due to a velocity of discharge equal to speed of ship, or 15 feet per second, 12,000 lbs.; net moment of resistance of ship, 9,000 lbs.; gross moment of resistance, 21,000 lbs.; total velocity of discharge of water to obtain that resistance or pressure, 20 feet per second; net indicated horse-power, 760. It would appear then from this, that the smaller the discharge-pipes, the better; but as the friction, of course, increases with the contraction of the pipes and the velocity of discharge, there will be a limit to this, and I have no doubt that that limit has been reached in the "Waterwitch."

There are, however, other peculiarities of this mode of propulsion, now well established and justly admired, which tend to prove the theory I have laid before you. I allude to the remarkable power displayed by vessels propelled on this principle, of starting ahead, and stopping. At first sight the combination of this power with an inferior propeller appears incompatible, but a little consideration will show that both are due to the same cause, viz., the necessity entailed on the vessel of giving a velocity equal to her own to the water used for propulsion.

For instance, for a speed of 15 feet per second for the "Waterwitch," it is necessary to discharge the water at the velocity of 30 feet per second, and we have a pressure at the back of the discharge-pipes available for propulsion equal to 9,000 lbs., but if, while the vessel is moving ahead at this speed, the orifice of the discharge-pipes were suddenly changed so as to discharge the water directly forward, evidently the whole of the pressure at the back of the discharge-pipes that, due to a velocity of 30 feet per second for the water, or 12,000 lbs., is brought to bear to stop her; and not only that, but all the water she is taking in is acting in the same direction, and only ceases when the vessel is brought to rest; in other words, a pressure equal to 15,000 lbs. is suddenly brought to bear to stop her; one portion of this force, equal to 3,000, is gradually reduced until the vessel is brought to rest, when it ceases, but is gradually brought into play again, as an opposing force, as the vessel gains her speed in the opposite direction to that in which she was before moving. In starting from rest, the vessel is impelled by an effective pressure proportionate to the whole velocity of discharge, which effective pressure is gradually reduced as weigh is got on the vessel; and in turning with the discharge-pipes, the whole of the force due to the reaction of discharge is brought effectively to bear. These are advantages peculiar to the plan; and when the ease with which the direction of the discharge can be changed without reference to the engine, is considered, cannot fail to have great weight with those who have to decide upon its adoption into the Service. But these advantages, great as they are, are not obtained without a sacrifice. A vessel, fitted as the "Waterwitch," must have inferior rudder-power to a vessel that throws a stream of water upon the rudder,

and therefore could not manœuvre so quickly in a running fight, or where it was required to turn rapidly without loss of speed.

There is one point more. I have seen it stated, that as it is ascertained that there is no advantage in having the discharge pipes of the hydraulic propeller immersed, therefore the motion of the vessel in a seaway will not interfere with her propelling powers; but though the immersion of the discharge-pipes may produce no beneficial effect, it does not follow that raising them a considerable height out of the water will not cause waste of power: it will, in fact, I think, cause great waste of power; for instance, suppose the discharge pipes to be fitted, as in the "Waterwitch," just above the water-line, and that the vessel is rolling 20° each way, this in the "Waterwitch" would raise each discharge-pipe alternately about 6 feet above the water-line, giving an average height of 3 feet that the whole of the water discharged, "nearly 400 tons a minute" would have to be raised by the engine without any compensating advantage, and is consequently a clear waste of power.

I have now arrived at this point, that for the various reasons I have endeavoured to make clear to you, I conclude, that for an internal propeller, the direct passage is greatly preferable in point of speed, but that the hydraulic principle, in proportion to its sacrifice in this respect, obtains a distinct, and in some cases valuable manœuvring power, but I have before stated that I have also arrived at the conclusion, that all internal propellers, of equal size with external ones, must fail in the primary object of speed; and that therefore the best propeller will be the one that combines within itself, in the greatest perfection, the good qualities of both the internal and external systems, and this is the principle upon which my propeller is constructed. It has the advantages of the internal propeller, in its freedom from fouling, by spars or rigging shot away in action, and from injury by an enemy's shot, &c. It gives superior manœuvring power to any other mode of propulsion, for it equals the screw in rudder-power, as the floats throw the water directly upon the rudder; it pivots the vessel on her centre, if two wheels are used and made to revolve in opposite directions; and is capable of propelling the vessel, either end first, with equal speed and facility. It is superior to the screw, as a submerged propeller, it being impossible under any circumstances for the motion of the ship, whether by pitching or rolling, to interfere in the least with its direct and steady action. It is equal to the eccentric paddle-wheel, in the directness of the action of the floats, but greatly superior to either radical or eccentric paddle in its steady and invariable immersion, and freedom from vibration, the floats never striking, or lifting the water, but sliding gradually, though rapidly, in and out of it Lastly, it is superior to either screw or paddle in the comparatively undisturbed, and unyielding water, that it is enabled by its position and superior immersion, to act upon.

In the competitive trials between the ordinary radial paddle-wheel and my propeller, applied to the same boat, and driven by the same engine, the immersed float area being equal in both cases, and the speed of the vessel also being equal, the power used by the ordinary paddle-

wheel was as 7 to 5 used by my propeller, the slip of the paddle-wheels being about 40 per cent., of my propeller about 17 per cent.

In turning with the common rudder, the paddles made the circle in 40″, my propeller in 30″.

Now of course these trials, though they were fairly made, cannot be considered decisive; they give, however, I think, a fair indication of the results to be anticipated, and indicate, I think, a certainty of obtaining, especially in a seaway, a very superior speed.

I have now touched upon the three most important points in estimating the value of a propeller, viz., speed, clear gun-decks, and freedom from fouling, and manœuvring powers.

In considering my plan with regard to the sailing qualities of vessels, I think that there can be little doubt but that the rounded inequalities in the bottom of the vessel fitted with my propellers will offer less resistance to the passage of the vessel through the water than the double stern-post of the single screw, or the drag of the disconnected twin screws; and I believe as little, if not less resistance than the friction of the numerous holes in the bottom of the hydraulic vessel, and the drag of the lee discharge pipes; I also believe that the double or treble keel (Figs. 2 and 3), which my plan necessitates, will add greatly to the vessel's stability.

With regard to space occupied, I am afraid that my plan, as here presented to you, will not bear quite so favourable a comparison, though I doubt if even here there will be much to complain of; I have the space occupied by the barrels and their cases, as compared with the space occupied with the screw alleys, in the screw vessel, and the space occupied by the turbine, and the different tubes, and water-passages, in the hydraulic vessel. In order to make an approximate comparison, I will give a rough estimate of the size of my barrels, supposing two barrels to be used. The length of each float, and consequently of each barrel, is one-third the beam of vessel, and the diameter of barrel, six times the required extended breadth of float; consequently, supposing that in a vessel of "Waterwitch" class, it was desirable to have 20 square feet of surface in each float, the barrels would be 10 feet long, and 12 feet in diameter, which would give my plan no very decided inferiority in this respect.

We now come to the last point, viz., that of expense, but notwithstanding its importance, I am afraid I can give no more than a very rough estimate of the relative expense of the different plans.

There can be no doubt but that the first cost of the screw, in itself, is by far the least, but the screw necessitates the expensive overhanging stern, in order to protect it; whereas both the hydraulic vessel and mine would have both ends alike. There will probably be no great difference between the first cost of my propeller, as explained to you to-night, and the hydraulic propeller; but the first cost of a propeller must be a comparatively small item in its value. The propeller that gives the highest speed, with the smallest consumption of fuel, must be the cheapest, and this, in anticipation I claim for mine.

The CHAIRMAN: Captain Simpson, as no doubt some questions will be asked you presently for information, perhaps you will be kind enough to take a note of them,

so as to answer them at the end. There are one or two points upon which I should like more information. The first is with regard to the friction of those studs that I see in the model. If they rise and fall, as I understand they do, I want to know whether the friction would not be excessive in them. In the next place I think you made mention that the drum would be water-tight. I do not trace any provision by which, if the studs are to rise and fall, the drum could be water-tight. Next, with regard to that casing that you put on below to shut the box up. I do not well see how that would be water-tight.

Admiral ELLIOT: I should like to ask a few questions. In the first place I have great delicacy in putting questions, for fear I should appear to be attempting to condemn a new motive power, which has never been tried except on a very small scale. Having decried that mode of action myself, I should be very sorry to set the example this night, but there are one or two questions I should like to ask Captain Simpson, which I am sure he will excuse, and not suppose I am trying to run his principle down. There was one point particularly which Captain Simpson mentioned the other evening with regard to the loss of power of the hydraulic. It has been proved by facts that there is no such loss of power, but I am not surprised at what Captain Simpson says, because even Mr. Brunel years ago, announced that by scientific analysis the hydraulic propeller must lose 50 per cent. of its power; and others went a great deal further than that. The question I would ask is this, supposing a vessel to be going twenty knots an hour, and supposing you fire your stern gun, as a stern chaser, will the recoil of that gun be retarded?* That is to say, will the reaction upon the rear of that gun be less in consequence of the speed at which the ship is going? Will not the recoil of that gun be exactly the same as if the ship was stationary? I ask this question, because the whole power that is obtained with the hydraulic, as in the "Waterwitch," is entirely the same as the recoil of a gun. I maintain that there is no loss of power whatever. If a ship is going fifty miles an hour, and you discharge the gun, a stern chaser, I ask Captain Simpson whether the gun will recoil more or less in consequence of the speed of the ship? If he says "No," then, I say, that the reaction which takes place on the nozzle by the discharge of the water, is exactly the same thing, and consequently no loss of power follows. That is one question I would put. Another question I would ask is, whether in the experiments that have been made on this very small scale with a screw, in a very light boat, the screw having been used in the same vessel as this new motive power, whether it was not at a disadvantage to what it would have been had it been used in a perfect vessel? I am alluding to the fact of the very large loss of displacement which takes place in that vessel, which must be given to the vessel in some other form, and consequently must produce in a larger vessel to drive—a greater direct resistance. I know that in the "Waterwitch" the loss of displacement due to the turbine and the canal is an objection. She has to get that displacement in her form in some other way, and she has to carry that body of water with her as she goes—so many tons of water due to the displacement which that space affords; which is, in fact, her carrying a heavier cargo. Here I notice that the loss of displacement is very considerable—that canal the whole length of the vessel, and those two large spaces there—that it is a very great loss. Added to which I would ask Captain Simpson, whether in the form of the vessel necessary to enable him to have this opening, he will not also find a very great loss by the abruptness of his horizontal lines? I would also ask whether he has ever thought, if a ship is rolling,

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* The whole of the reaction or recoil due to the discharge of a gun over the stern, is felt by the ship, whatever her speed may be, because the charge which gives that recoil has, before it is fired, a velocity equal to that of the ship; but a power necessary to move that charge at that velocity has been used, and in order to make the cases of the discharge of the gun and the discharge of the water by the hydraulic vessel parallel, it would be necessary that the whole of the water to be discharged by the hydraulic vessel should be stored up within her, failing this the cases are not parallel, and the argument in no way touches my theory of the action of the hydraulic propeller as stated in my paper.—C. H. S. (4th October, 1867).

and that canal is filled with water, whether in that case the water will be passing through of its own accord, or whether the rolling of the ship will not throw the water upon each side of that canal, and create some retarding influence upon the speed of the ship, or be a loss of power to his engine? Captain Simpson also talked of raising the nozzles a considerable height above water. I would ask Captain Simpson whether he has ever heard it mentioned by any one who advocates the hydraulic principle, that the nozzle should be lifted more than just its own height above the water-line. Added to the loss of displacement which occurs, I would ask whether a vessel upon that principle must not necessarily be a heavier vessel in her hull, consequently creating a greater amount of displacement necessary to a greater resisting power of vessel. I would also ask, as Captain Simpson has referred to the speed of the "Waterwitch," whether, providing he is informed that a series of trials at different speeds of engine have been made from twenty revolutions up to forty revolutions, and it was found that, as the speed of the ship increased, it in no way disturbed the law, which law is, that the power is as the cubes of the speed, whether it would not shake his opinion, that as you increase the speed of the vessel, you increase the loss of power. I must now ask him to excuse me for putting so many questions.

Captain SIMPSON: Would you put that last question again?

Admiral ELLIOT: Provided you were satisfied that a series of experiments were made to test the very point upon which you have been expressing a strong opinion, namely, that as the speed of a ship increases, you get increased loss of power; whether, if you are satisfied that a series of experiments having been made at different speeds of ship, from twenty revolutions of the engine up to forty, it was found that the law—(that the power is as the cubes of the speed)—became strictly correct in every instance, whether that would shake your opinion with regard to the loss incurred by the speed of the vessel? I would, by way of explaining that more fully, ask this question. Supposing the speed at which the water was discharged from the nozzles was equal only to the speed of the vessel, whether Captain Simpson, according to his theory, maintains that the whole power would be lost. He said that the power that was obtained was only due to the speed that the water was discharged at, beyond what the speed of the vessel was. But if I discharge water through a larger pipe, and discharge it exactly at the same speed as the vessel, namely, 10 knots, and that I get the same results as by using a smaller pipe and discharging the water at double the speed of the vessel, then where is Captain Simpson's theory? Because there is a vessel at this moment building at Liverpool for a tug, in which the discharge of the water is at a very much lower speed than in the "Waterwitch." It is done for a special purpose. She is to be a tug-boat, and it was thought that the heavier momentum of water, would be more advantageous. But I maintain that if you discharge the water through the pipe at the same speed that the ship is going, by having larger pipes and the same power, you will obtain the same speed as by discharging it at double the rate she is going, with half the quantity of water.

The CHAIRMAN: If no other gentleman would like to make any remarks, I will call upon Captain Simpson to reply.

Captain SIMPSON: I think the first question was with regard to the barrel being water-tight. The compartments are water-tight, but in this instance the cases in which the floats work are not water-tight, are not supposed to be water-tight. If it is an advantage that they should be water-tight they could easily be made so. There is no great quantity of water that will get in there. Simply a sufficient quantity of water will get in to ease the friction. There is always a slight friction in drawing the floats out, but it must be remembered that there are only two floats at the same time moving, and I believe the friction will be less than in the feathering paddle-wheel, where all the floats are always moving. With regard to the three or four questions put by Admiral Elliot—

The CHAIRMAN: I beg your pardon, I also asked about the tightness of the compartment below.

Captain SIMPSON: This top I simply took off the model in order to show the working; but I conclude it would be closed except in a small space, enough to lift the float when required to be examined, and then it would be all water-tight. This outer casing would be built in the bottom of the vessel, and built in one, not slipped

in, as it is here. In an iron vessel it would be built into the vessel; if in a wooden vessel, it would be caulked. With regard to the three or four remarks that Admiral Elliot made, with regard to this vessel, this, as I said in my paper, was not a plan that I recommended, it was one that I tried. I gave up the internal passage as I believed it to be inferior to the float acting on the external principle.

Admiral ELLIOT: I beg your pardon, I thought you said the contrary.

Captain SIMPSON: I simply brought it to show you I had followed out my ideas in this. The internal passage might be used with a larger propeller; and, no doubt according to the size of that passage, the displacement would be in proportion to the weight of water carried. There is no question about that. I believe the floats acting externally would not only give a higher speed, but would also occupy less space. The next question was with regard to the discharge of a gun. I think I stated before, that the whole of the reaction of the water discharged did re-act upon the back of the nozzle. It did not signify how slow it was going, or how fast, the whole reaction due to the velocity of the discharge is, undoubtedly, felt at the back of the nozzle; but what I said was, that when the vessel is moving ahead the water will not enter of its own accord, but the engine has to draw it in; and as she passes on, she is continually drawing fresh water in. She has not simply the body of water there and it remains there, but she is continually drawing fresh water in, and taking it from a state of rest as she is moving; consequently every particle of water she takes in, she has to give a velocity to, equal to her own. It is drawn in at right angles, and she cannot draw any particle of that water in, without giving it a velocity equal to her own velocity. It has nothing to do with what the engine does at all. The ship itself does it, and the ship's momentum is destroyed in proportion to that; consequently the discharge must be increased to overcome that destruction of momentum.

Admiral ELLIOT: I am sure it will not be objected to that we should just settle this point. There are two distinct considerations involved in Captain Simpson's last remarks. One the entrance of the water, and the other the imparting to that water the velocity of the ship. Now as to the supply of water to the turbine. I maintain that as that supply is due entirely to the atmospheric pressure, or, as the water will always rise to its own level, the entrance of the water into the turbine is entirely done for you; and that there is no power of engine exerted to produce that effect. The moment you move the engine the turbine moves, if a bucket of water is taken out, that bucket of water is immediately replaced by the atmospheric pressure acting upon the water outside, and there is no loss of power due to the entrance of the water into the turbine. As to the second consideration, I acknowledge that apparently the momentum of the vessel has to be imparted to the water taken up, and that this would create a retarding influence to its speed, but as the entrance of the water into the canal is before the turbine, and as it is carried through the turbine at a speed greater than the speed of the vessel, its flow, although diverted from a straight line, is not arrested, and it does not appear that there is any loss of power sustained by this lifting up of the water, when at rest, and forcing it out again.

Captain SIMPSON: If the engine had not to do any work in driving the water through, the vessel might be propelled without any engine power. At any rate that is my idea of it, that the vessel takes in the water. If she takes it in at the end, as in my model (Fig. 4 *a*), the water flows through of its own accord. If she takes it in at the side (Fig. 4 *b*), the water will not flow through of its own accord; she has to take it in as she is moving rapidly forward; consequently, the water must have the velocity given to it that the vessel has, and the vessel's momentum must be destroyed, in giving to that water, that velocity. I quite believe with Admiral Elliot, that the power that is due is as the cubes of the speed, certainly with the turbine. "This unbalanced pressure," according to Dr. Robinson, "is equal to the weight "of a column having the orifice for its base, and twice the depth under the "surface of the water in the trunks for its height. This measure of the height "may seem odd, because, if the orifice were shut, the pressure on it is the weight "of a column reaching from the surface. But when it is open, the water issues "with nearly the velocity acquired by falling from the surface, and the quantity "of motion produced is that of a column of twice this length, moving with this

"velocity." That I believe to be the result in this; that the reaction of the discharge is simply due to that. If a vessel goes at ten feet a second, you discharge your water at twenty feet, and if you double your speed, you double your discharge. With regard to the fact, that the ship may be propelled at the same speed at which the water is discharged, if that is not proved, it is a thing which I should deny. I believe, as soon as it arrives at the same velocity—in fact, it never can arrive at the same velocity—the vessel's speed will be immediately slackened, because the moment of resistance of the ship will be greater than the power.

Admiral ELLIOT: I believe it is contrary to the rule to rise again else I could explain that at once.

The CHAIRMAN: You may do so.

Admiral ELLIOT: For the sake of argument I will just explain again. If you acknowledge that the power that is obtained is entirely by reaction, if I discharge a column of water of double the size at half the speed, I get a reaction upon a larger area, and therefore I get the same power. It is a column of water discharged at one speed, *versus* another column of water at another speed, the reaction in both instances being a certain pressure per square inch upon a given area. It comes to the same thing, that you would get the same reaction in both instances, and that the speed of the ship, as I said just now, has nothing whatever to do with it. It is not slip nor is it loss of power at all. It is just the same as the stern chaser of a ship, the gun will recoil the same, and so the water will do exactly the same work, whether the vessel is going fifty miles an hour, or whether it is stationary.

Captain SIMPSON: I think I mentioned that you alter the size of the nozzles. My idea in altering the size of the discharge-pipes was this:—"I believe that if "the discharge-pipes in the 'Waterwitch' were increased to four times their pre-"sent area of 3,845 square inches, the result would be nearly as follows, that the "pressure at the back of the discharge-pipes due to the velocity of the discharge, "equal to the speed of the ship, or equal to fifteen feet per second, would be equal "to 12,000 lbs."

General BOILEAU, R.E., F.R.S.: If I may be permitted to make one observation as a landsman, it is in a mechanical point of view that I do so, not with the object of calling in question the design or principle which Captain Simpson has enunciated, because I do not quite comprehend the explanation which he has just given of the water entering into the turbine. The question that I would wish to put, is likely to illustrate to my mind and satisfy it on the point upon which there appears to be a difference of opinion between Admiral Elliot and Captain Simpson. One says—and I think with considerable truth as regards the mechanical question—that the engine is not necessarily the agent for supplying water into the turbine, because the pressure of the atmosphere would fill up any quantity of water that might be taken away, supposing, of course, that the water continued in contact with the sides of the vessel, therefore the engine power is not necessary to fill it. If, as the lecturer says, the engine power is necessary, and that the vessel going through the water with a certain velocity, the water would not enter through the orifice of the turbine, might I ask in case of a shot-hole being made in the side of a ship in action, and the ship is going at the rate of fifteen knots an hour, would the water enter the hole?

Captain SIMPSON: Of course it will.

General BOILEAU: Then the water must enter here.

Captain SIMPSON: You are talking of taking the water out with a bucket, or with your hand; and in that case you make yourself the engine if you lift the water up.

The CHAIRMAN: I think we must terminate this discussion, because we shall be getting into an irregularity in asking questions after the lecturer has concluded, particularly when we have got another subject to be brought forward. I believe, whatever our opinions may be, we must be grateful and thankful to the Lecturer for giving us this description, though we may not all agree with what he has said. There are some points in which I dare say some of us differ from him—at any rate we all feel enlightened by what he has said. Every invention brought before us must enlarge our ideas, and lead the way to other improvements, therefore I think we are very much obliged to Captain Simpson for his paper.

Captain SIMPSON: I must express my thanks for the manner in which you have given attention to my explanations.

THE SPAKOWSKY MARINE AND ARMY NIGHT TELEGRAPH.

By Captain H. H. Doty.

The importance of a reliable and simple means of a speedy communication at night between vessels and military stations, is too well known by the officers of both branches of Her Majesty's service to require comment here.

In presenting the *Spakowsky Signal Light* to your notice, I do not seek, nor do I desire to make any innovations upon the code recently adopted by the Government, but simply to offer a powerful auxiliary to that system of communication.

The instrument which produces the light, weighs about 7lb. avoirdupois weight, is about 3ft. in length, and in shape resembles closely an ordinary civic mace, the resemblance to which is heightened by its being made of brass. Its staff, about 2in. diameter, is a hollow cylinder, inside which is fitted a piston that can be pressed down to two separate distances in the cylinder, but which, when not in use, is kept in the upper portion by a strong spiral spring in the lower part of the cylinder of staff. Immediately over the top of the piston, and at the upper part of the cylinder, is a projecting nozzle pipe through which the air finds entrance on the opening of a valve by drawing the piston downwards. The upper portion of the cylinder is now full of air, which will be driven out on the piston being released by the operator's hand, and being forced upward by the spiral spring underneath. In the upper portion of the instrument is a cotton wick, kept burning by a small spirit-of-wine lamp fixed in the head of the mace-like top. Opposite to the small flame of the spirit-lamp is about an inch of horizontally fixed brass tubing of about the thickness of whip-cord, terminating in a needle point from another piece of the same tubing—one being a continuation of the other—and pointing direct at the spirit flame. A reservoir in the head of the instrument contains a little over half a pint of petroleum, and this reservoir is connected with the two small pieces of tubing, and by means of them subsequently with the air from the cylinder below. The piston being released, is driven upward by the spring underneath, and forces the air through the small tubes in the face of the flame, and with it the petroleum in the form of a vapour. The result of this is, that a column of flame of full $2\frac{1}{2}$ inches in diameter, darts upwards from the point of contact between the petroleum vapour and the flame of the lamp, and this column of light lasts just so long as the piston is moving upwards again to its normal position in the cylinder. The length of time during which the column of light is shown, depends therefore, upon the length to which the piston is pressed downwards in the cylinder. Thus a 2-inch movement of the piston may be said to give a short flash, and a 6-inch movement to give a long flash. A mechanical

catch in the cylinder warns the signalman when he has reached the proper distance for a short or a long flash.

This light may be worked at all times, during high wind and rain, the flame being protected from these elements by a lantern, which covers the top of the lamp.

Permit me to briefly enumerate a few of the many advantages of this light.

1stly. Its ordinary strength and brilliancy, which, without the aid of a reflector or lens, is many times more powerful than any light hitherto known, and which, by the application of oxygen to its flame, may be made more brilliant than the oxy-calcium and other powerful lights which have been put aside, in consequence of the many disadvantages attending their use.

2ndly. It may be flashed from the deck or masthead of a vessel, and seen from all points of the compass at the same instant. For instance, a "general order" from the Commander-in-chief might be telegraphed from the masthead of the flag-ship, or head-quarters in the field, and be simultaneously received by the fleet, or the several divisions of an army.

3rdly. Its simplicity in construction and mode of operation will render it in the hands of any person endowed with ordinary intelligence, a safe and reliable medium of communication between ships, armies, coast-guard stations, and railways.

I have in the press an universal code of night signals for the Mercantile Marine (see Appendix), and I have full confidence that ere long (by means of this light), signals will be made at night, and understood by vessels of all nations.

For an account of a series of trials recently made with this light at Portsmouth, I beg to be permitted to quote from the London *Times*, of the 10th instant, as follows :—

Signal Lights.

A series of experimental trials have been made at Portsmouth during the past week, by order of the Admiralty, with a night signal-lamp which has just been introduced into this country, the results of which appear to promise what has long been wanted to perfect the night telegraphic system of her Majesty's fleets—a certain and reliable, economical, brilliant, and simply working flash-light. The light referred to as having been tried at Portsmouth appears to possess all the desired qualities as a flashing signal light. It has been introduced to the notice of our Admiralty by one of the inventors, a Captain H. H. Doty, and it is so far well known that it is now the signal light of the Imperial Navy of Russia. After submitting the apparatus to the inspection of the Board at Whitehall, Captain Doty proceeded, by their lordships' order, to Portsmouth, and on arrival there placed himself in communication with Admiral Sir Thomas Pasley, Port Admiral and Commander-in-Chief, to make arrangements for a thorough trial of his light. Sir Thomas Pasley appointed Captain Charles Fellowes, her Majesty's ship "Duke of Wellington," and Captain James G. Goodenough, her Majesty's ship "Minotaur," to carry out the trials of "the Spakowsky Marine and Army Night Telegraph," and report officially upon its results. On the first night of the trials, signalling was carried on after nine p.m. between the "Duke of Wellington," in Portsmouth harbour, and the "Minotaur," at Spithead, Captain Fellowes being provided with a Spakowsky lamp on board the "Duke," and Captain Goodenough on board the "Minotaur." The lights read and repeated the signals

made from ship to ship with extraordinary clearness and quickness to the operators, and its success as a "light" simply and without regard to other considerations, which are rightly the province of Captains Fellowes and Goodenough to decide upon, was at once placed beyond a doubt. The second experiments were made for the purpose of examining some of the smaller details connected with the working of the light, and were made in the presence of Admiral Sir Thomas Pasley and other officers, and were also quite satisfactory. On Monday night last the paddle steam-tender "Sprightly," Master-Commander Allen, steamed out of Portsmouth harbour in the midst of a gale of wind and rain until outside the Nab Light-vessel, seven nautical miles from the Spit-buoy, and when there, carried on rapidly and freely a series of signals with the "Minotaur" frigate at Spithead, again proving the value of a good light to the new code. On Tuesday night Captain Fellowes and Captain Doty, by permission of Lieutenant-General Sir George Buller, K.C.B., took up a position on the ramparts of Fort Southwick, the central and most elevated of the Portsdown line of forts, and from there signalled for upwards of an hour with the "Minotaur," lying at Spithead. A dense haze lay on the water and over Portsmouth, between the fort and the frigate, but the petroleum lights penetrated through all, and delivered and received their messages without a check. It is, perhaps, necessary to observe that no night glasses of any kind were allowed to be used, nor were they required in reading a signal. The cost of its working can best be shown by an experiment made with it by Captain Fellowes, who, commencing with its reservoir newly filled with petroleum (a little over half a pint), flashed 1,470 long and 1,460 short flashes before the petroleum gave out. This would average about 400 words telegraphed, at under a shilling cost. This cheapness in working the light, and also in its purchase, would seem to indicate its suitability for a signal light for the mercantile marine. Supposing that two steamships were approaching each other at night, and the commanders of each wished to know the position of the other's helm, the long and short flashes of the signal light could at once ascertain it by spelling the words in the usual manner, or if there should not be time for that, to let the short flash stand for the short word, and the long flash for the long word—the short flash for "port," and the long flash for "starboard."

THE following code, referred to as being in the Press, which has been brought out to conform with, and as an auxiliary to, the Commercial Code of Signals, will explain the system of Flashes as they were exhibited before the meeting.—30*th December*, 1867. H. H. D.

DOTY'S

UNIVERSAL CODE FOR NIGHT SIGNALS, BY THE "SPAKOWSKY LIGHT."

An Auxiliary to the "Commercial Code of Signals."

(The Commercial Code has been adopted by the principal Governments of Europe and America.)

THIS "NIGHT SIGNAL LIGHT" is easily distinguished from all other Lights now in use; it presents a Columnar Flame of great brilliancy, which is exhibited in Short and Long Flashes; the Short Flash being about one second in duration, and the Long Flash about three seconds.

DIRECTIONS.

If you wish to correspond with a Vessel or Signal Station, you will first note the letters in the "Commercial Code," which may indicate what you desire to say; then proceed to flash the Short and Long Flashes as they are set (in this Table) until answered by the Vessel or Station called.

Call—A continued succession of Flashes -

Answer—A number of Long Flashes - - -

When answered, make the Flashes as they are set in the Alphabetical Column opposite the letters you may employ.

Example - (L) (R) (S)

Keep a Look-out for a Light—(See *Commercial Code*).

Yes—Three Long Flashes - - - - - - -

No—One Short, Two Long, and One Short - - -

Repeat—(Repeat your Signals) - - - -

Stop - - - - - - - - - -

GENERAL SIGNALS.

Pilot—Call for a Pilot, Four Long - - - - -

Answer—Pilot's Answer - - - -

To Avoid Collision—On sighting a Vessel dangerously near, without being able to make out her course, flash—

Our Helm is Port—Continued Short Flashes -

Our Helm is Starboard—Ditto Short and Long

Distress—Alternately Three Long and Three Short Flashes - -

N.B.—The above simple "Code" may always be relied upon by observing the following

RULE.—The Flashes for the first letter should be repeated two or three times before proceeding to Flash the second letter, which latter should (in like manner) be repeated two or three times before Flashing the next, &c.

An interval of six or eight seconds should elapse between the Flashes for each letter.

H. H. DOTY.

ENTERED AT STATIONERS' HALL.

Distinguishing Letters

To denote the Nationality of the Vessel making the Signal, always to be given before the name of the Vessel, and to be followed by a number of quick Short Flashes, before flashing the letters for the Name.

E—England
F—France
R—Russia
P—Prussia
U—United States
I—Italy
A—Austria
T—Turkey
S—Spain
PL—Portugal
BM—Belgium
D—Denmark
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N—Norway
SN—Sweden
B—Brazil
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